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Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

CANMET

Canada Centre for Mineral and Energy Technology
Centre canadien de la technologie des minéraux et de l'énergie

POTASH MINING PROJECT

PROJET D'EXPLOITATION DE LA POTASSE

IDENTIFICATION OF INPUT PARAMETERS FOR NUMERICAL MODELLING OF POTASH STRATA AT INTERNATIONAL MINERALS AND CHEMICAL CORPORATION (CANADA) LIMITED

December 1988

Report by:

INTERNATIONAL MINERALS AND CHEMICAL CORPORATION (CANADA) LIMITED
Esterhazy, Saskatchewan

Prepared by:

MRAZ PROJECT CONSULTANTS LTD
Saskatoon, Saskatchewan

Work on the Project was conducted under the auspices of the Canada Centre for Mineral and Energy Technology, Energy, Mines and Resources Canada.

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MICROMEDIA

162 + figures

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The participants included various International Minerals & Chemical Corporation (Canada) Limited personnel who directed and assisted during the project, in particular, the mining engineering departments at both the K-1 and K-2 mines whose manpower and equipment were used extensively both to install and monitor instrumentation.

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SECTION 1.0

1.0 EXECUTIVE SUMMARY

International Minerals & Chemical Corporation (Canada) Limited (IMC) and Mraz Project Consultants Ltd (MPC) jointly submitted an unsolicited proposal dated October 1986, bearing an overall title of "Identification of Input Parameters for Numerical Modelling of Potash Strata at IMC." The joint proposal of IMC and MPC was accepted by the Department of Supply and Services, and DSS Contract Serial No. 23440-6-9005/01-SQ was initiated.

The objective of the research proposal was to install rock mechanics instrumentation in selected mining panels and record the pressure changes in the pillars, roof and floor as mining progressed through these panels. These results, combined with laboratory testing of core samples from the mining panels, would then be used to calibrate numerical models of the mining panels. Once the numerical model had been calibrated with this field data, existing mining panel geometries could be characterised and other mining geometries tested with an objective to optimize ore recovery under different mining conditions.

Two rock mechanics stations sites were selected at the IMC minesite; the K-2 mine, Panel 13H station in an area containing sylvinite ore with a relatively low content of carnallite and the K-1 mine, Panel 12E station in an area containing sylvinite ore with a relatively high content of carnallite.

The single rooms required to establish each rock mechanics station were mined in the approximate center of the panels to establish the background or 'virgin ground' stress conditions prior to mining of additional rooms.

Core samples of the ore bed were recovered for laboratory testing from both test sites.

A full array of rock mechanics instrumentation was installed at both sites. Instrumentation at the K-2 site commenced on January 23, 1987, and was completed March 20, 1987. Instrumentation readings were recorded manually. Installation at the K-1 site commenced on May 12, 1987, and was completed June 19, 1987. Instrumentation readings were recorded by a remote data acquisition system.

This report records the installation and instrumentation details, field data and laboratory testing results of core samples. Analysis of field data and laboratory testing results are included as an addendum to this report.

This Final Report is submitted in compliance with the terms of the contract.

1.0 RESUME EXECUTIF

International Minerals & Chemical Corporation (Canada) Limited (IMC) et Mraz Project Consultants Ltd (MPC) ont conjointement soumis une proposition non-solicitee datee d'octobre 1986, portant le titre general "Identification de parametres initiaux pour la modelization numerique du comportement des couches de potasse d'IMC." La proposition d"IMC et de MPC fut acceptee par le Ministere des Approvisionnements et Services et leur contrat No: 23440-6-9005/01-SQ fut initie.

Deux sites furent choisis a la mine d'IMC, un a la mine K-2 dans un panneau minier contenant du minerai de sylvinite et un niveau relativement bas de carnallite et l'autre a la mine K-1 dans un panneau minier contenant de la sylvinite carnallitique. Ceux-ci furent choisis afin de fournir un echantillonnage varie des differentes conditions dans les panneaux miniers, jusqu'a l'excavation complete des panneaux et jusqu'au point ou le plein rechargement des tractions verticales se produit.

Les salles requises pour chacun des postes d'instrumentation furent etablis dans le centre des panneaux afin de quantifier d'avance les conditions bases des contraintes ("donnees vierges") et aussi durant l'excavation des chambres et piliers aux alentours.

Les carottes-echantillons furent prelevees des deux sites pour des essais en laboratoire. Le carottage commenca au site K-2 le 15 decembre 1986 et fut complete le 23 janvier 1987. Le carottage commenca au site K-1 le 16 juin 1987 et fut complete le 19 juin 1987. Les essais en laboratoire n'etaient pas termines au moment de ce rapport et seront rapportes a une date ulterieure, comme appendice a ce rapport.

Un ensemble complet d'instrumentation pour la mecanique des roches fut installee a chacun des deux sites. Il y avaient des instruments pour surveiller la cloture du toit au plancher, la cloture de cote-a-cote, et les pressions principales sur les piliers.

L'installation au site K-2 commenca le 23 janvier 1987 et fut completee le 20 mars 1987, les donnees instrumentales sont notees manuellement et ce poste continue a etre operationnel. Au moment d'ecrire, ce panneau n'a pas ete completement mine et le plein rechargement des pressions "vierges" ne s'est pas produit.

L'installation au site K-1 commenca le 12 mai 1987 et fut completee le 19 juin 1987. Les donnees instrumentales furent enregistrees par un systeme a distance installe a cause de l'instabilite anticipees (correctement) dans le toit. Les cellules de pression au poste K-1 ont failli et le poste abandonne apres la recuperation de tout l'instrumentation qui pouvait etre recupere en toute securite. Les donnees, les graphes et leur interpretation sont inclus dans ce rapport.

Le nivellement ne fut pas fait pour determiner l'etendue a laquelle l'intrusion du plancher contribue a la cloture totale aux galeries.

L'analyse des donnees obtenues en place est ci-inclus. Les resultats des essais en laboratoire seront fournis a une date ulterieure avec les donnees mises a jour acquises en place.

Ce rapport est soumis sous les termes du contrat. Les appendices seront envoyes lorsque les donnees additionnelles seront disponibles.

SECTION 2.0

2.0 INTRODUCTION

The IMC minesite is located in southeastern Saskatchewan near the town of Esterhazy (Figure 2.1).

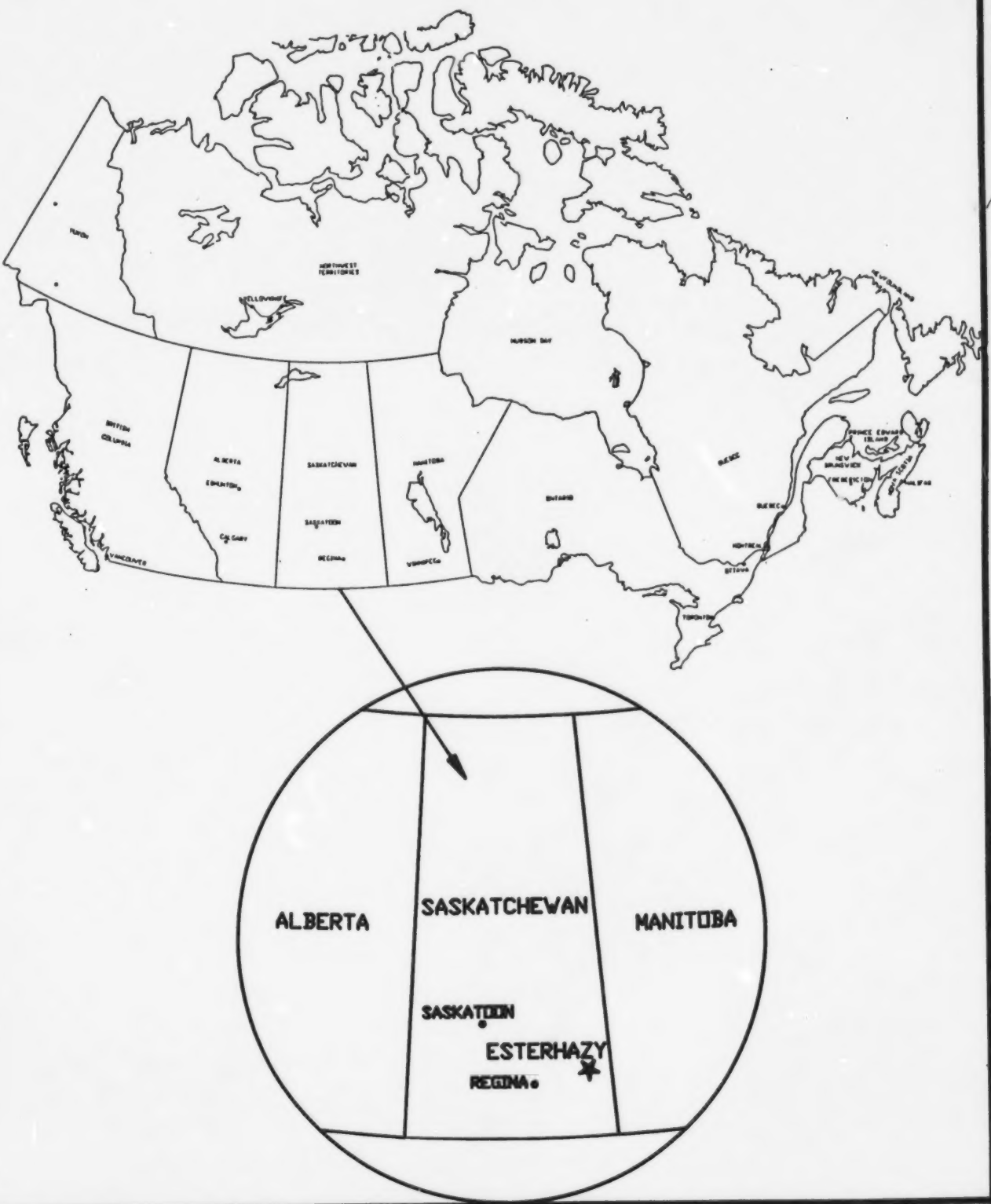
Two test sites were selected at the IMC minesite, one at the K-2 mine, Panel 13H and the second at the K-1 mine, Panel 12E (Figure 2.2).

Figure 2.3 shows a typical section of the ore zone.

The K-2 test site is located at the southeast boundary of the property and designated as the Panel 13H Rock Mechanics Station. The carnallite and sylvite grades in this panel are shown in Figures 2.4 and 2.5.

The K-1 test site is located at the northwest boundary of the property and designated as the Panel 12E Rock Mechanics Station. The carnallite and sylvite grades in this panel are shown in Figures 2.6 and 2.7.

Both rock mechanics stations are located within active mining panels. Both panels were mined using twin rotor Marietta mining machines.



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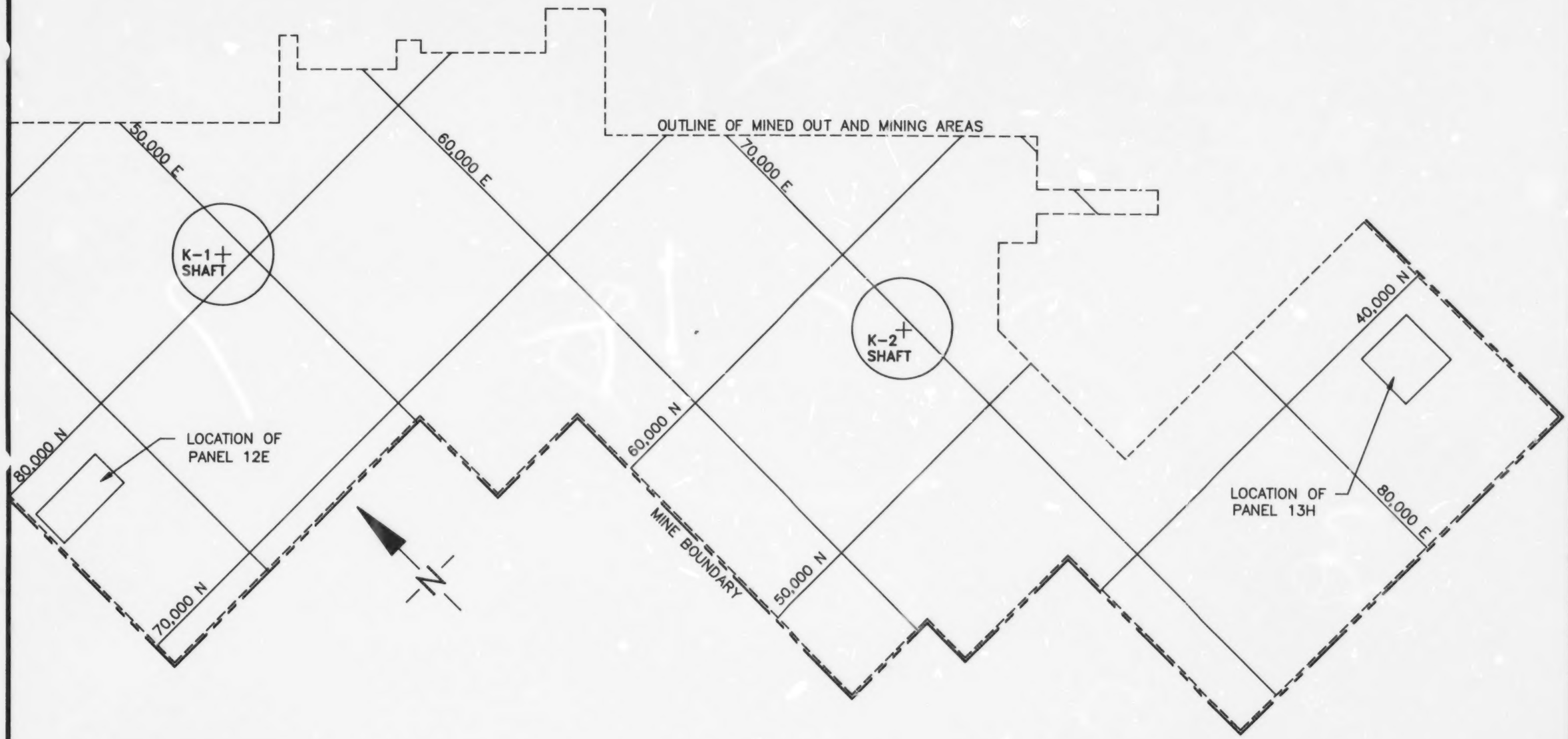
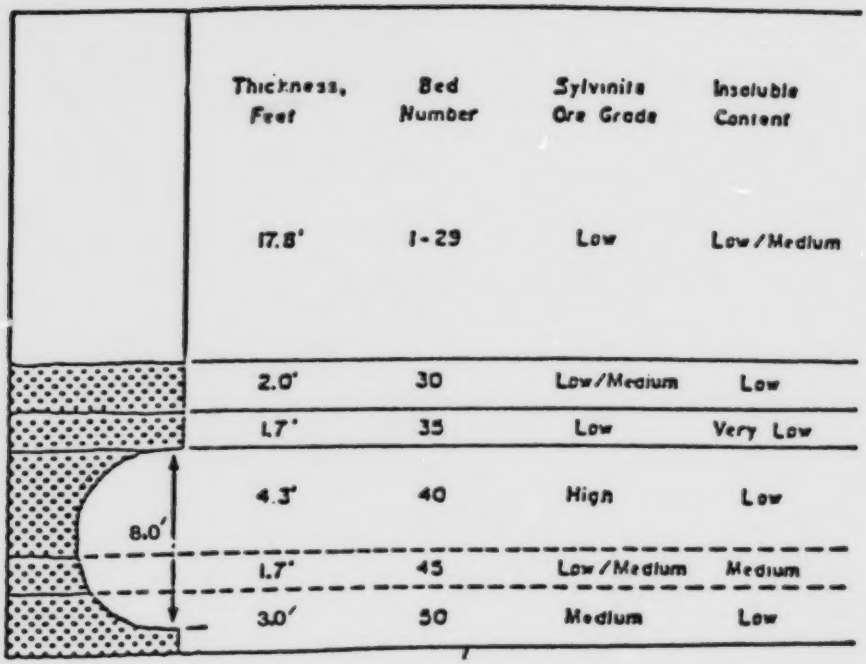
TELEX 074 - 2636 HINZ SKN TELEFAX 955-0244

FIGURE 2.1
LOCATION MAP,
ESTERHAZY, SASKATCHEWAN
CANADA.



DWN. DATE : FEBUARY 12, 1988	MPC Mraz Project Consultants Ltd.	**TITLE :** INTERNATIONAL MINERALS & CHEMICAL CORP. (CANADA) LTD.	**SCALE :** N.T.S.
DWN. BY : DWAYNE B. GUDMUNDSSON	410 JESSOP AVE. SASKATOON, SASKATCHEWAN, CANADA S7N 2S5 Ph. (306) 955-0240 TELEX 074 - 2636 HINZ SKN TELEFAX 955-0244	PLAN SHOWING LOCATION OF PANELS 12E AND 13H	**DRAWING NUMBER :** FIGURE 2.2



30.0' Total Section Thickness

TYPICAL SECTION - ORE ZONE 1. (AFTER KEYES, 1966)

FIGURE 2.3

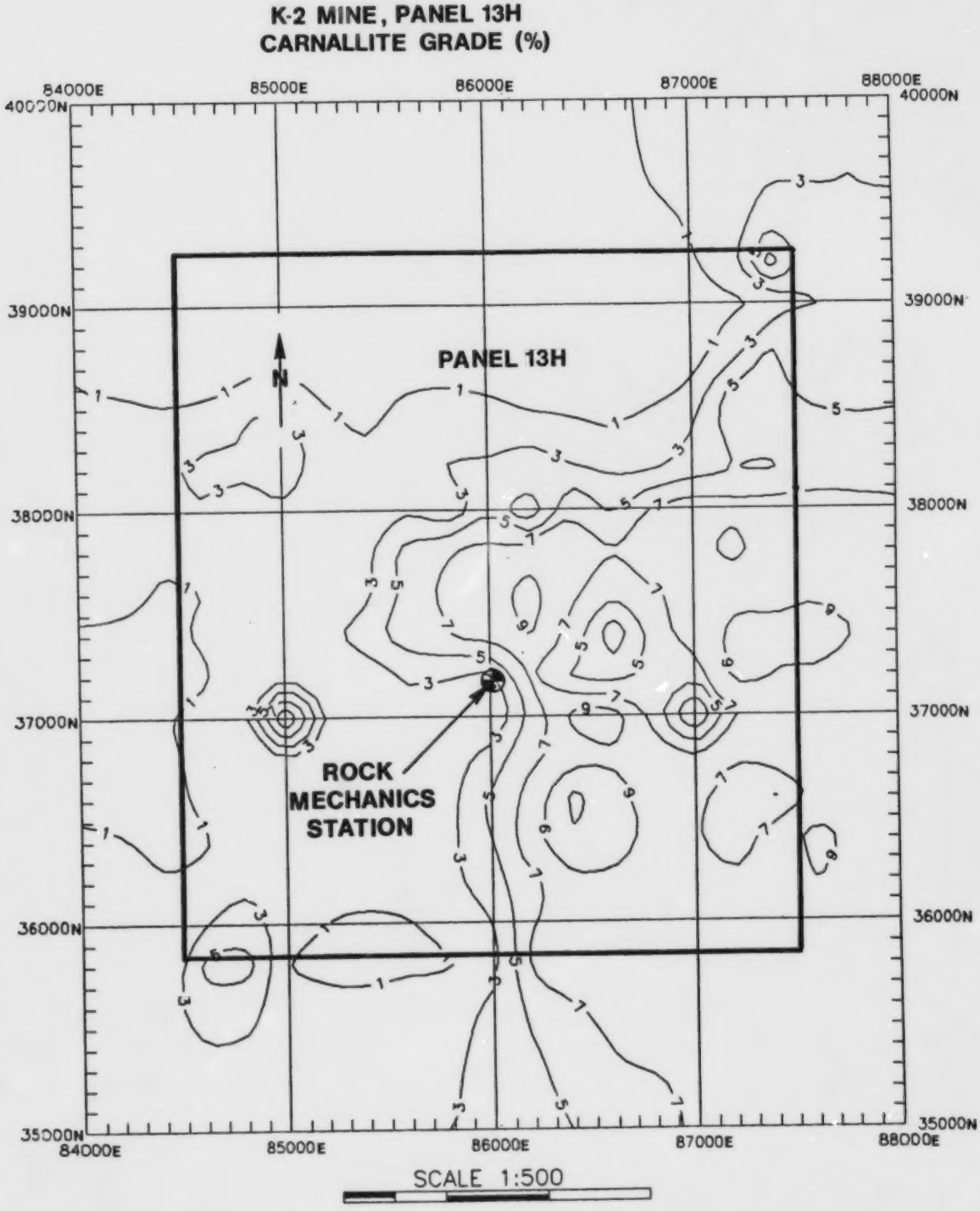

K-2 MINE, PANEL 13H
CARNALLITE GRADE (%)
84000E
85000E
86000E
87000E
88000E
40000N
39000N
38000N
37000N
36000N
35000N
PANEL 13H
N
ROCK
MECHANICS
STATION
SCALE 1:500

FIGURE 2.4

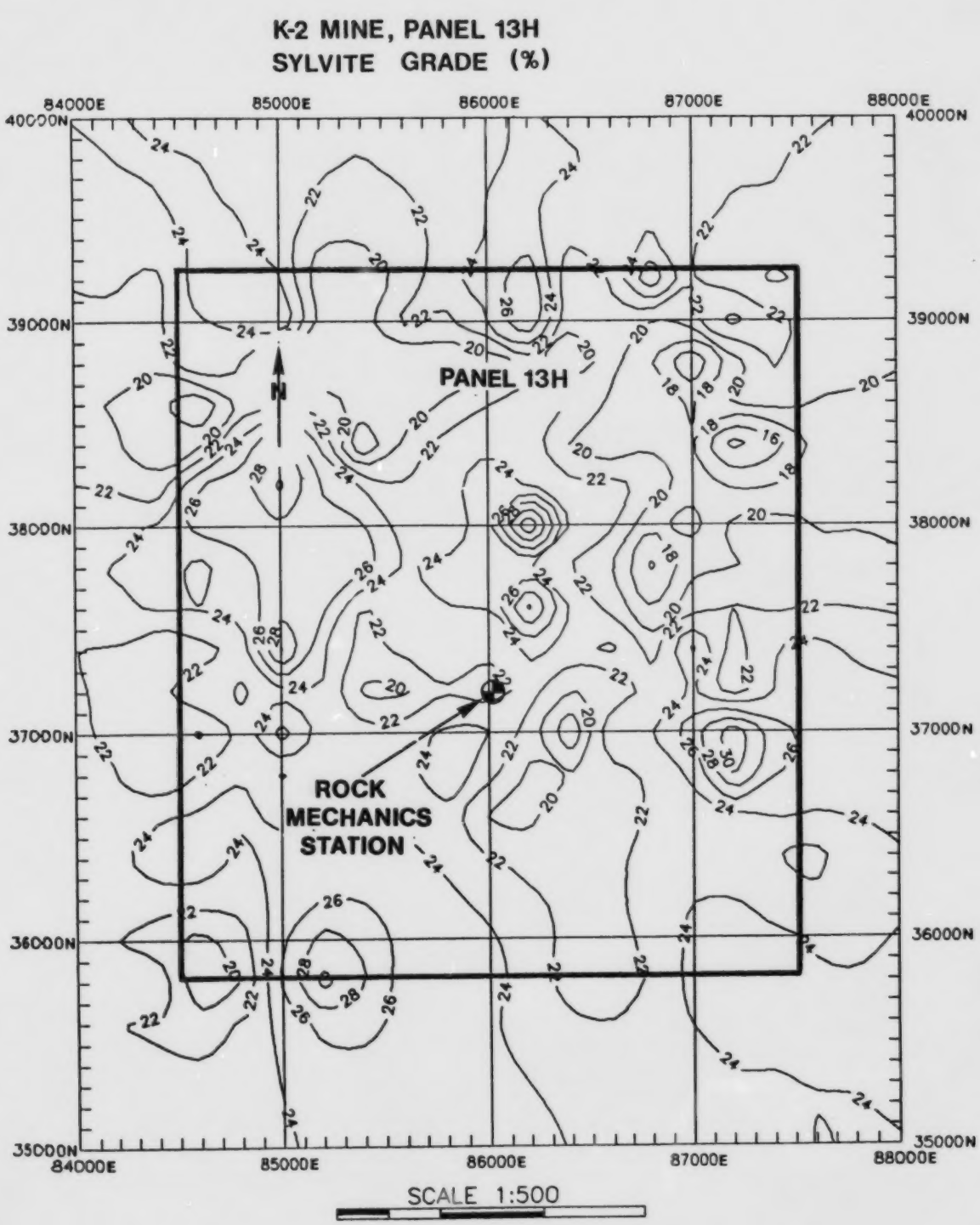

K-2 MINE, PANEL 13H
SYLVITE GRADE (%)
84000E
85000E
86000E
87000E
88000E
40000N
39000N
38000N
37000N
36000N
35000N
PANEL 13H
N
ROCK
MECHANICS
STATION
SCALE 1:500

FIGURE 2.5

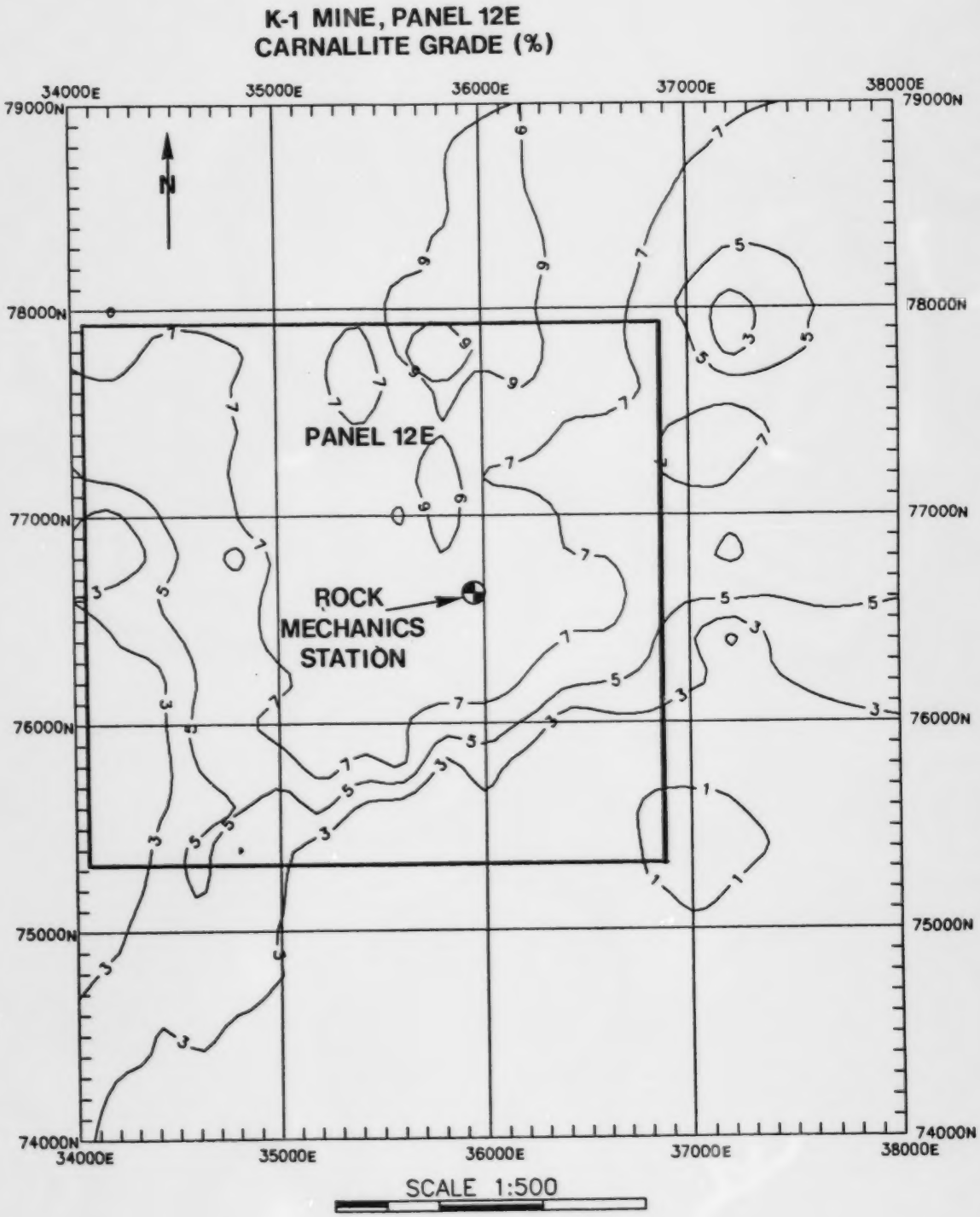

K-1 MINE, PANEL 12E
CARNALLITE GRADE (%)
34000E
35000E
36000E
37000E
38000E
79000N
78000N
77000N
76000N
75000N
74000N
N
PANEL 12E
ROCK
MECHANICS
STATION
SCALE 1:500

FIGURE 2.6

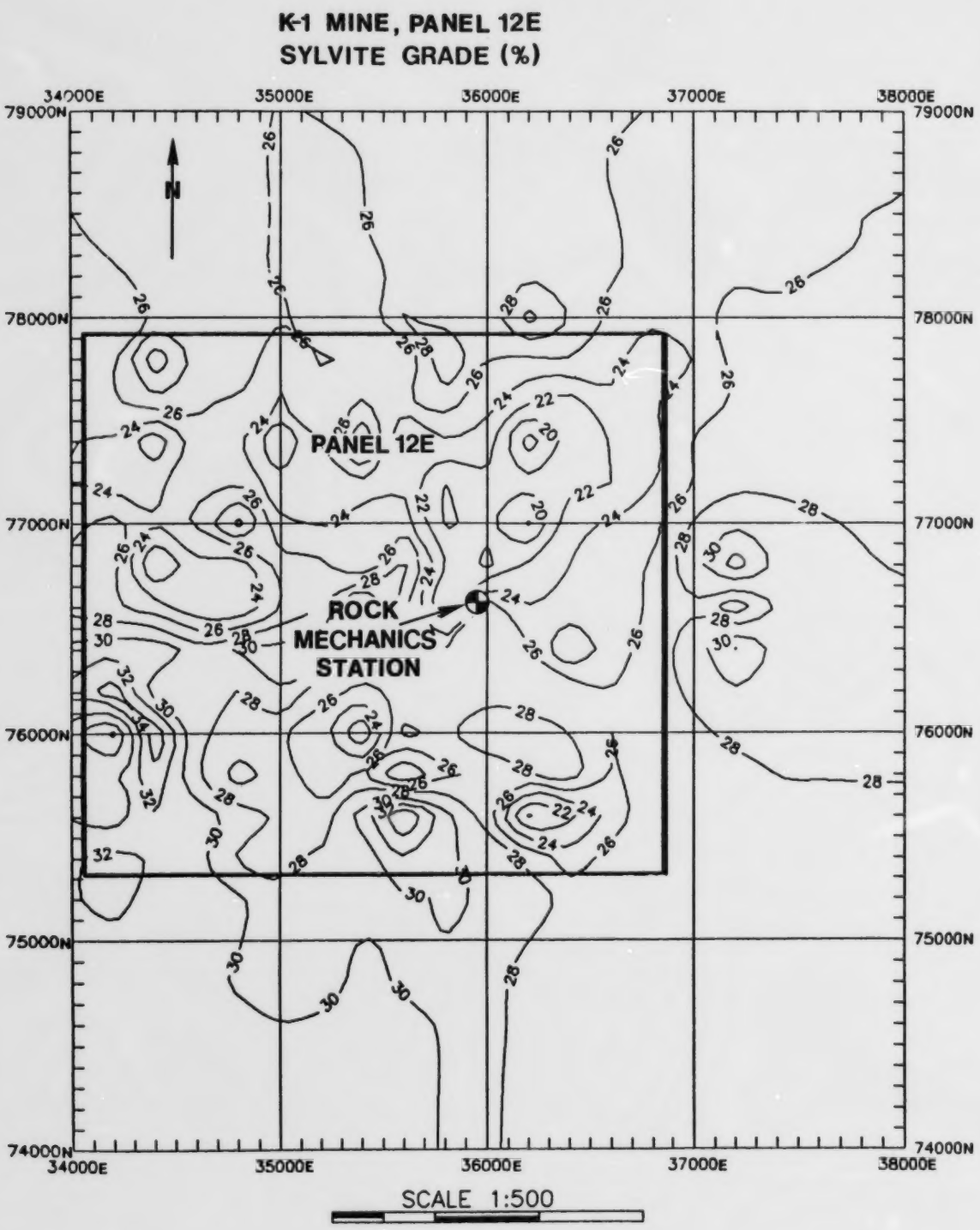

K-1 MINE, PANEL 12E
SYLVITE GRADE (%)
34000E
35000E
36000E
37000E
38000E
79000N
78000N
77000N
76000N
75000N
74000N
N
PANEL 12E
ROCK
MECHANICS
STATION
SCALE 1:500

FIGURE 2.7

SECTION 3.0

3.0 RESEARCH OBJECTIVES

The objectives of the research program were stated in the original proposal as follows:

Phase I - Rock Property Characterization

1) To quantify the rheological properties of Esterhazy ore through laboratory testing and in-situ measurements.
2) To compare the rheological differences between sylvite and carnallite ore.
3) To establish a data base for future design calculations and possible numerical modelling.
4) To establish a data base for the assessment of Phase II.

Phase II - Monitoring of a Site In an Active Mining Panel

1) To determine the long term behaviour of pillars with respect to overburden movement.
2) To determine the extent to which floor intrusion contributes to total opening closure.
3) To determine the magnitude of extension that is induced into the overburden.
4) To provide a data base for future overburden support and backfill calculations.

SECTION 4.0

4.0 IN SITU TESTING IN PANEL 13H

The test site in Panel 13H was selected so as to locate the rock mechanics station initially in "virgin" ground.

Room 13H040 was excavated before retreat mining from the northern boundary of the panel was initiated.

Installation and commissioning of instrumentation was completed while mining activities were about 800 feet away to the north. The response of the test site instrumentation to the advancing mining machine was then monitored.

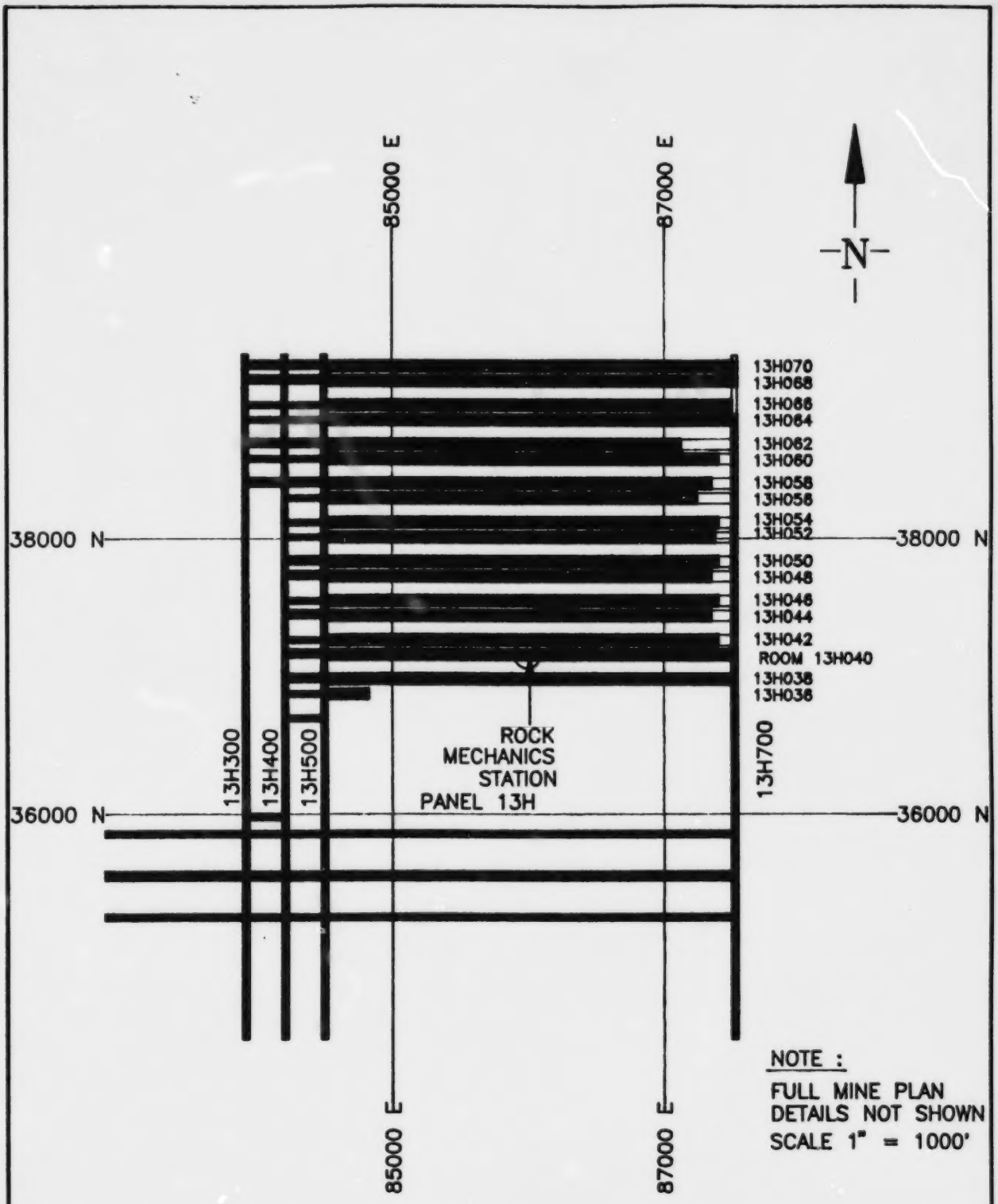
Field data results included in this report cover the period February 20, 1987, to February 8, 1988.

4.1 Location, Timing, Mining Sequence and Instrumentation Description

The location of this Rock Mechanics Station is shown in Figure 4.1. Note mining machine position as of February 8, 1988, relative to the Rock Mechanics Station.

The progress of the mining machine (120 miner) in each room of Panel 13H is summarized in Table 4.1 and Figure 4.2. Instrumentation drilling was completed on March 4, 1987. Cell installation and grouting was completed on March 20, 1987.

The instrumentation layout is shown schematically on Figure 4.3.



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DWN.# MPC-0039-B | DATE: OCT 25, 1988

DWN. BY: DWAYNE B.GUDMUNDSSON

FIGURE 4.1
INTERNATIONAL MINERALS AND CHEMICAL CORP. (CANADA) LTD.
K-2 MINE, PANEL 13H
LOCATION OF ROCK MECHANICS STATION IN PANEL 13H

TABLE 4.1

K-2 MINE, PANEL 13H
MINER LOCATION

DATE	DAYS	ROOM	FOOTAGE FROM START OF MINING ROOM					
20-Feb-87	0							
27-Mar-87	35	BT48						
01-Apr-87	40	13H050	80					
08-Apr-87	47		540					
15-Apr-87	54		1050					
23-Apr-87	62		1720					
30-Apr-87	69		2400					
06-May-87	75		2700					
08-May-87	77	13H048		0				
15-May-87	84			800				
29-May-87	98			1430				
04-Jun-87	104			1650				
10-Jun-87	110			2125				
19-Jun-87	119			2406				
29-Jun-87	129	SHUTDOWN						
09-Jul-87	139	13H046			0			
23-Jul-87	153				1000			
29-Jul-87	159				1600			
16-Aug-87	177				2900			
20-Aug-87	181	13H044				220		
31-Aug-87	192					580		
11-Sep-87	203					1085		
16-Sep-87	208					1200		
29-Sep-87	221					2100		
07-Oct-87	229					2590		
16-Oct-87	238	13H042					180	
22-Oct-87	244						600	
26-Oct-87	248						780	
30-Oct-87	252						1170	
02-Nov-87	255						1400	
05-Nov-87	258						1600	
10-Nov-87	263						1900	
13-Nov-87	266						2300	
16-Nov-87	269						2510	
25-Nov-87	278						2750	
02-Dec-87	285	13H038						30
15-Dec-87	298							1000
18-Dec-87	301							1220
05-Jan-88	319							1550
07-Jan-88	321							1850
19-Jan-88	333							2500
29-Jan-88	343	13H036						0
05-Feb-88	350							50
08-Feb-88	353							300

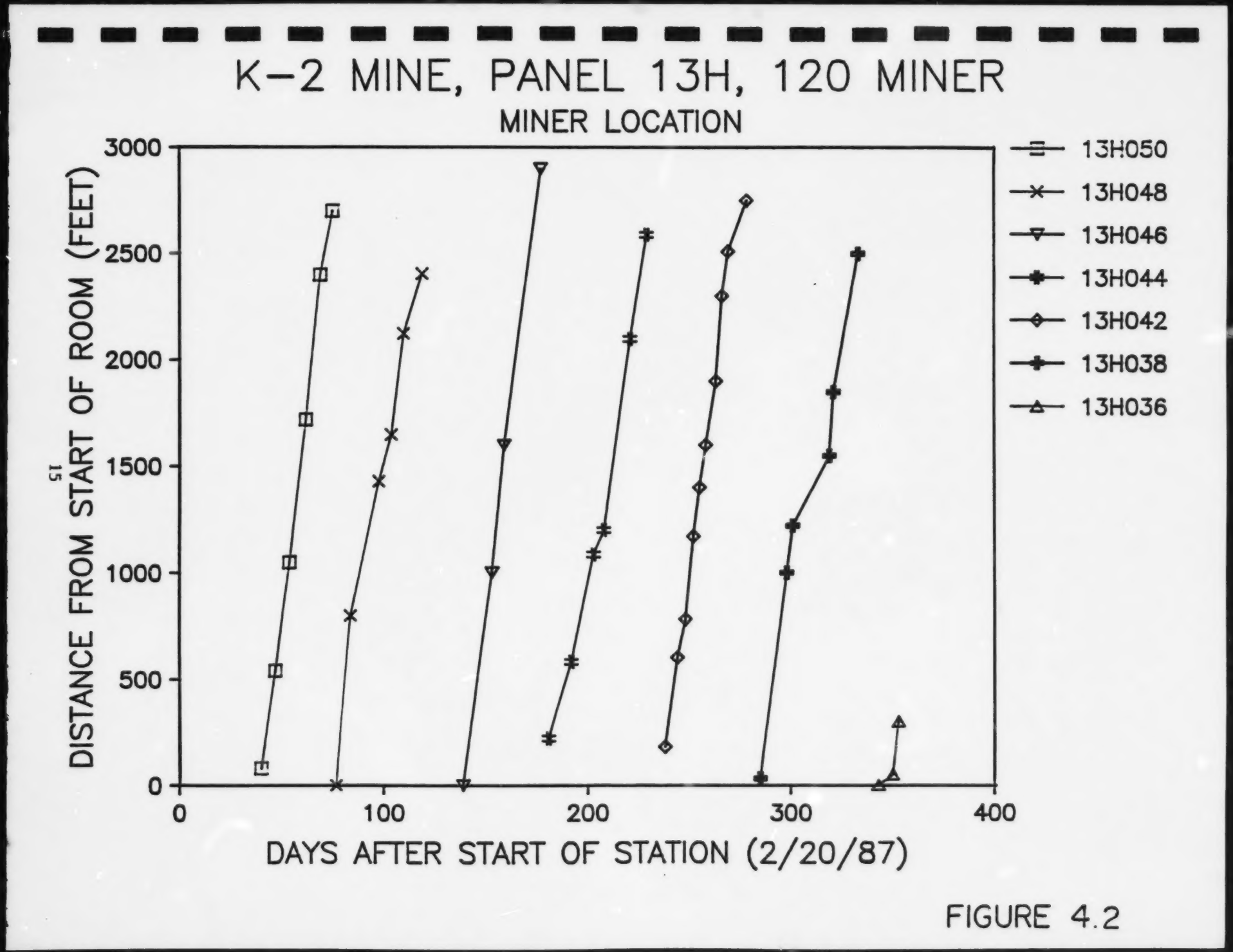

K-2 MINE, PANEL 13H, 120 MINER
MINER LOCATION
DISTANCE FROM START OF ROOM (FEET)
3000
2500
2000
1500
1000
500
0
0
100
200
300
400
DAYS AFTER START OF STATION (2/20/87)
13H050
13H048
13H046
13H044
13H042
13H038
13H036

FIGURE 4.2

The instrumentation installations in Room 13H040, Panel 13H are described as follows:

Vertical Closure Stations

These instruments were installed as shown in Figure 4.3 to measure changes in the distance between the roof and floor, i.e. to measure convergence or dilation.

The reference points for vertical closure are 2 x 1/2" long Hilti pins driven into the floor and roof, the latter immediately above the other. The distance between fixed reference points on the pins is measured with a HI stick for a reading.

Vertical closure stations were located at the north rib, the center of the room and the south rib in a plane normal to the centerline of the room.

Horizontal Closure Station

This instrument was installed as shown in Figure 4.3 to measure changes in the distance between the north and south ribs, i.e. to measure convergence or dilation.

The reference points for horizontal closure are pins driven into the north and south ribs at the mid-point of the height of the excavation at the rib. An Invar wire is attached to a potentiometer-type closure meter and between the two pins.

One installation was located immediately east of the large (south) pillar 6-point extensometer in a plane normal to the centerline of the room.

Borehole 6-Point Extensometer

This instrument was installed as shown in Figure 4.3 to measure relative movement or strain at different depths in the roof and large (south) pillar.

The reference points for relative movement or strain are anchors established at 5, 10, 15, 20, 25 and 30 foot depths, respectively, within a borehole in the roof and pillar and the potentiometers at the collar of the hole. The anchors were attached with stainless steel wires to the rotary-style potentiometers that are capable of registering very small movements in the anchors.

One installation was located in the roof at center of the room and a second in the large (south) pillar.

Borehole Rod and Plate Extensometer

This instrument was installed as shown in Figure 4.3 to measure relative movement or strain at different depths in the floor and small (north) pillar.

The reference points for relative movement or strain are anchors established at 10, 20 and 30 foot depths, respectively, within individual boreholes for the floor and 5, 10 and 15 foot depths, respectively, within individual boreholes for the small (north) pillar and the reference plate at the collar of the holes. A steel rod anchored at the required depth (with roof support chemical resin) travels the length of the hole through the reference plate at the collar. A collar on the steel rod is aligned with a reference point on the plate. The movement of the steel rod relative to the collar plate is measured with a dial gauge accurate to .001 of an inch.

Radial Pressure Cells

Saskatchewan Research Council (SRC) hydraulic pressure cells were installed to measure radial pressure in the large (south) pillar at 5, 10, 15, 20 and 25 foot depths as shown in Figure 4.3.

The cells were installed in 2 1/8" diameter boreholes to the specified depth with the pressure face normal to the direction of radial pressure. To achieve this, a notch was cut out in the large pillar wall by the Marietta miner and the installation boreholes drilled so as to place the pressure cells parallel to the vertical centerline of the Room 13H040.

Tangential Pressure Cells

SRC hydraulic pressure cells were installed to measure vertical or tangential pressure in the roof at 10 and 20 foot depths, the large (south) pillar at 5, 10, 15, 20 and 25 foot depths and the small (north) pillar at a depth of 15 feet as shown in Figure 4.3.

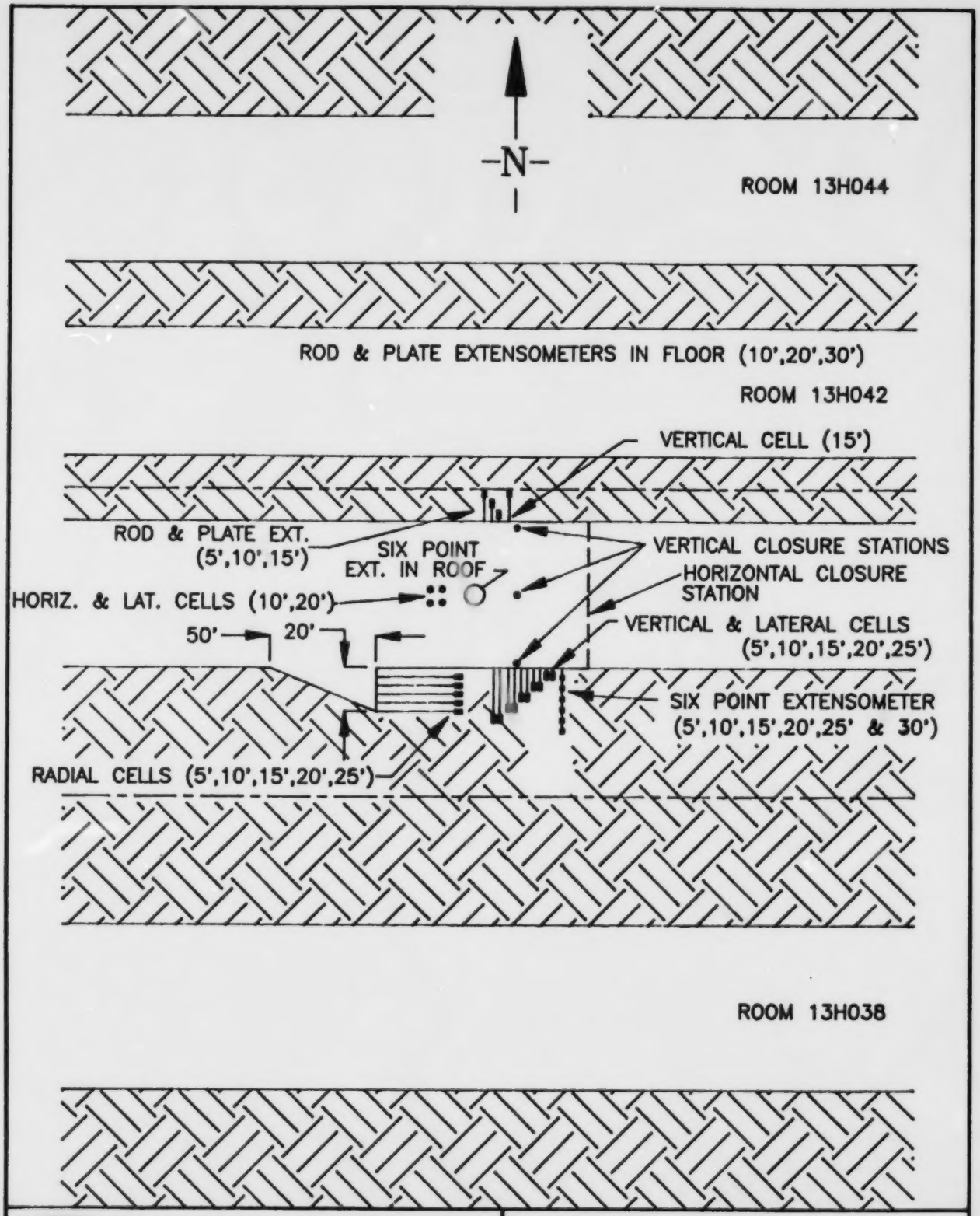
The cells are installed in 2 1/8" diameter boreholes to the specified depth with the pressure face normal to the direction of tangential pressure, i.e. parallel to the horizontal centerline of the room when installed in the pillar and parallel to the vertical centerline when installed in the roof.

Lateral Pressure Cells

SRC hydraulic pressure cells were installed to measure lateral pressure in the roof at 10 and 20 foot depths and the large (south) pillar at 5, 10, 15, 20 and 25 foot depths.

The cells are installed in 2 1/8" diameter boreholes to the specified depth with the pressure face normal to the direction of lateral pressure, i.e. normal to the longitudinal axis of the Room 13H040.

Boreholes containing pressure cells were fully grouted with a cementitious grout. Pressure readings were taken by means of pressure gauges at the borehole collar that were attached to the pressure cells by means of stainless steel tubing.



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DWN.# MPC-0039-D | DATE: OCT. 25, 1988

DWN. BY: DWAYNE B.GUDMUNDSSON

FIGURE 4.3
INTERNATIONAL MINERALS AND CHEMICAL CORP. (CANADA) LTD.
K-2 MINE, PANEL 13H
VIRGIN GROUND ROCK MECHANICS STATION - ROOM 13H040

4.2 Closure Instrumentation

The following tables and figures record data for the closure instrumentation in Room 10H040.

TABLE 4.2

K-2 STATION, PANEL 13H, ROOM 13H040
VERTICAL CLOSURE STATIONS

		PIN A		PIN B		PIN C	
DATE	DAYS	ABSOLUTE CLOSURE (INCHES)	CUMULATIVE CLOSURE (INCHES)	ABSOLUTE CLOSURE (INCHES)	CUMULATIVE CLOSURE (INCHES)	ABSOLUTE CLOSURE (INCHES)	CUMULATIVE CLOSURE (INCHES)
20-Feb-87	0	88.430	0.000	81.520	0.000	85.910	0.000
27-Mar-87	35	88.290	0.140	81.330	0.190	85.730	0.180
01-Apr-87	40	88.260	0.170	81.300	0.220	85.700	0.210
08-Apr-87	47	88.230	0.200	81.250	0.270	85.660	0.250
15-Apr-87	54	88.190	0.240	81.220	0.300	85.630	0.280
23-Apr-87	62	88.130	0.300	81.130	0.390	85.580	0.330
28-Apr-87	67	88.070	0.360	81.080	0.440	85.520	0.390
15-May-87	84	87.980	0.450	80.920	0.600	85.400	0.510
22-May-87	91	87.880	0.550	80.860	0.660	85.340	0.570
04-Jun-87	104	87.780	0.650	80.680	0.840	85.280	0.630
10-Jun-87	110	87.650	0.780	80.600	0.920	85.146	0.764
16-Jun-87	116	87.530	0.900	80.460	1.060	85.029	0.881
24-Jun-87	124	87.430	1.000	80.344	1.176	84.935	0.975
13-Jul-87	143	87.270	1.160	80.140	1.380	84.770	1.140
23-Jul-87	153	87.190	1.240	80.060	1.460	84.687	1.223
20-Aug-87	181	86.160	2.270	79.400	2.120	84.164	1.746
27-Aug-87	188	85.920	2.510	79.239	2.281	84.018	1.892
31-Aug-87	192	85.873	2.557	79.185	2.335	83.945	1.965
11-Sep-87	203	85.725	2.705	79.022	2.498	83.851	2.059
16-Sep-87	208	85.630	2.800	78.919	2.601	83.770	2.140
29-Sep-87	221	85.428	3.002	78.236	3.284	83.178	2.732
07-Oct-87	229	85.162	3.268	77.924	3.596	82.914	2.996
16-Oct-87	238	85.015	3.415	77.761	3.759	82.753	3.157
22-Oct-87	244	84.922	3.508	77.652	3.868	82.655	3.255
26-Oct-87	248	84.856	3.574	77.585	3.935	82.587	3.323
30-Oct-87	252	84.781	3.649	77.498	4.022	82.509	3.401
02-Nov-87	255	84.624	3.806	77.314	4.206	82.343	3.567
05-Nov-87	258	83.881	4.549	76.691	4.829	81.820	4.090
10-Nov-87	263	82.516	5.914	76.210	5.310	80.894	5.016
13-Nov-87	266	82.243	6.187	76.259	5.261	80.634	5.276
16-Nov-87	269	82.048	6.382	76.085	5.435	80.455	5.455
25-Nov-87	278	81.691	6.739	75.779	5.741	80.141	5.769
02-Dec-87	285	81.493	6.937	74.859	6.661	80.001	5.909
18-Dec-87	301	81.138	7.292	74.531	6.989	79.651	6.259
05-Jan-88	319	80.602	7.828	73.685	7.835	78.962	6.948
07-Jan-88	321	80.305	8.125	73.366	8.154	78.488	7.422
19-Jan-88	333	79.809	8.621	73.153	8.367	77.889	8.021
29-Jan-88	343	79.599	8.831	72.889	8.631	77.616	8.294
05-Feb-88	350	79.459	8.971	72.330	8.441	77.525	8.114
08-Feb-88	353	79.421	9.009	72.285	8.411	77.498	8.084

K-2 STATION, PANEL 13H, ROOM 13H040

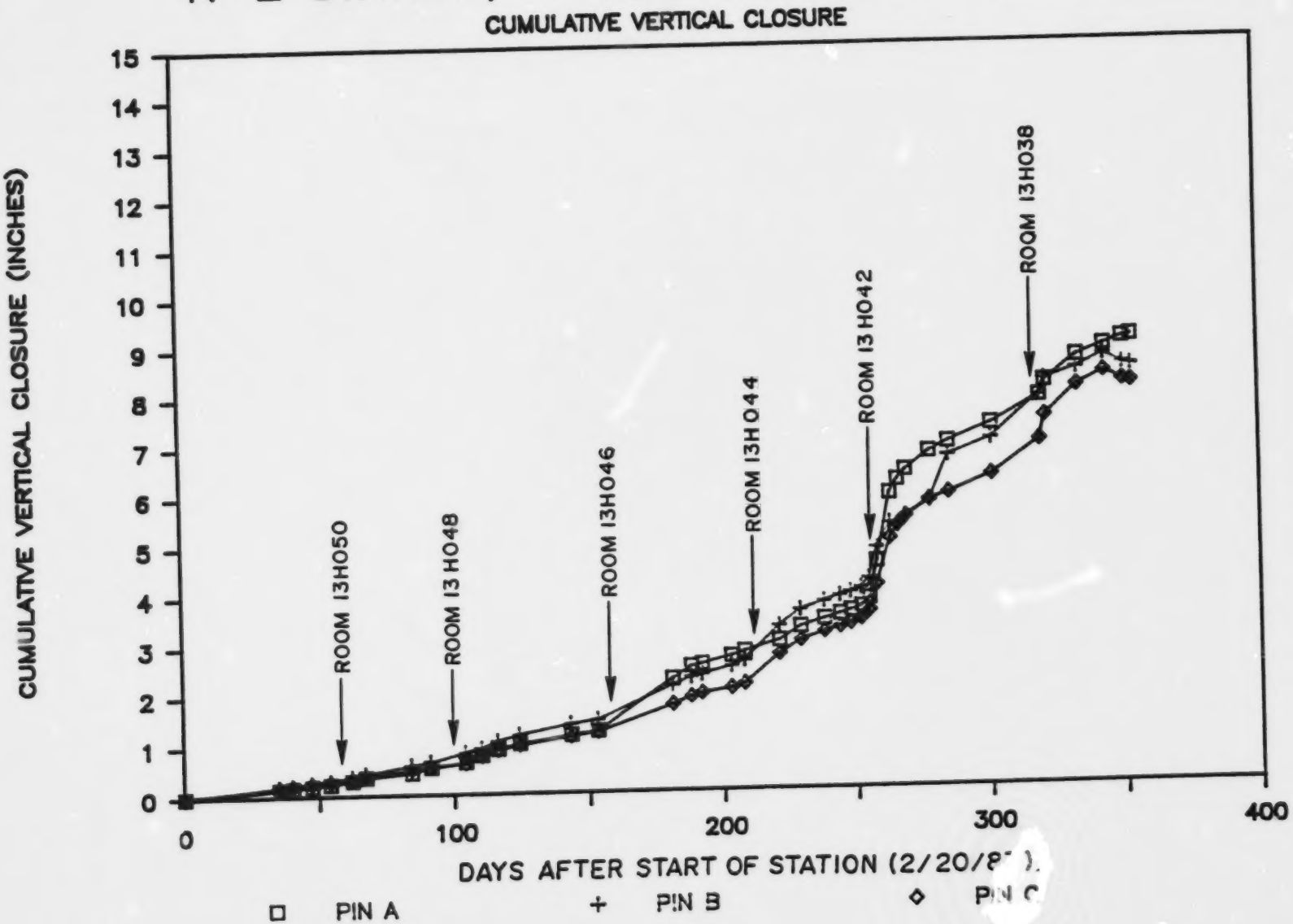


FIGURE 4.4

K-2 STATION, PANEL 13H, ROOM 13H040

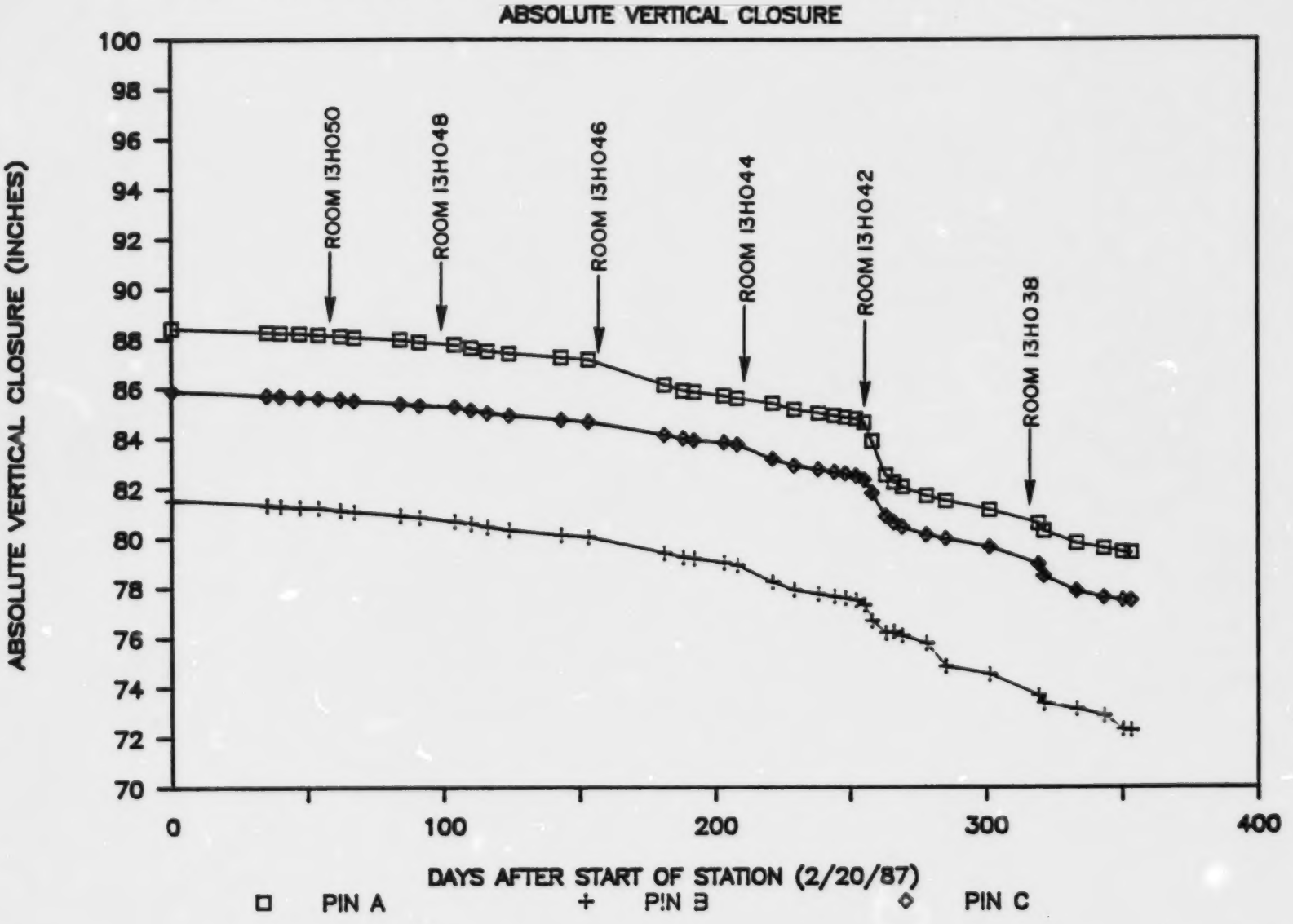


FIGURE 4.5

TABLE 4.3

K-2 STATION, PANEL 13H, ROOM 13H040
HORIZONTAL CLOSURE STATION

DATE	DAYS	READING (FEET)	CUMULATIVE CLOSURE (FEET)	CUMULATIVE CLOSURE (INCHES)
20-Feb-87	0	-	-	-
29-Jun-87	129	71.654	-	-
30-Jul-87	160	71.609	0.045	0.545
20-Aug-87	181	71.601	0.053	0.637
27-Aug-87	188	71.596	0.058	0.702
31-Aug-87	192	71.584	0.070	0.839
16-Sep-87	208	71.581	0.073	0.881
29-Sep-87	221	71.474	0.180	2.158
07-Oct-87	229	71.426	0.228	2.735
16-Oct-87	238	71.392	0.262	3.148
22-Oct-87	244	71.375	0.279	3.348
26-Oct-87	248	71.363	0.291	3.488
30-Oct-87	252	71.293	0.362	4.339
03-Nov-87	256	71.273	0.381	4.571
05-Nov-87	258	71.193	0.461	5.530
13-Nov-87	266	70.975	0.679	8.149
16-Nov-87	269	70.932	0.722	8.665
25-Nov-87	278	70.870	0.784	9.409
02-Dec-87	285	70.834	0.820	9.841
18-Dec-87	301 *	71.110	-	-
05-Jan-88	319	70.993	0.937	11.245
07-Jan-88	321	70.517	1.413	16.957
19-Jan-88	333	70.316	1.614	19.369
29-Jan-88	343	70.220	1.710	20.521
05-Feb-88	350	69.880	2.050	24.601
08-Feb-88	353	69.780	2.150	25.801

* RESET

K-2 STATION, PANEL 13H, ROOM 13H040

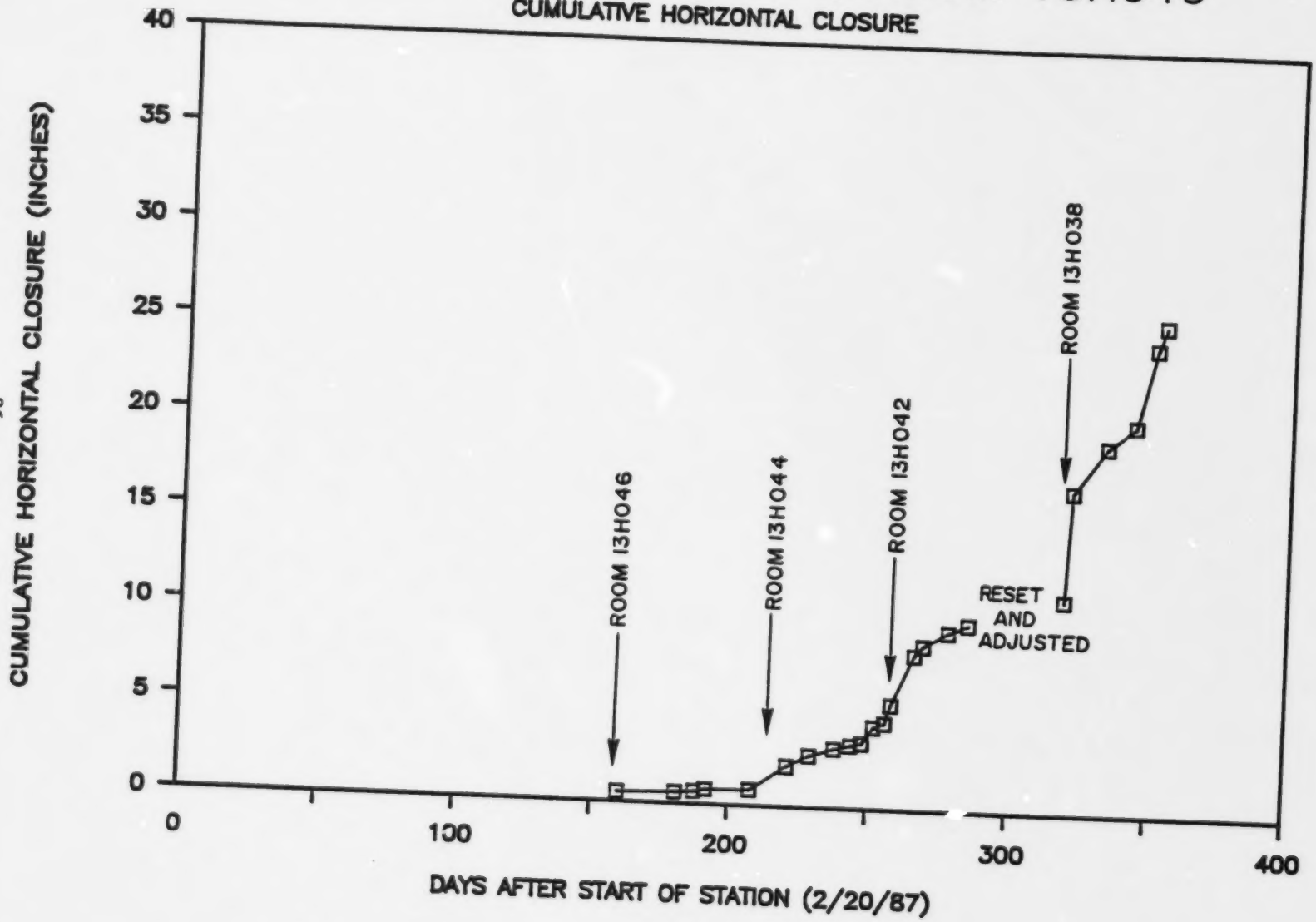


FIGURE 4.6

K-2 STATION, PANEL 13H, ROOM 13H040

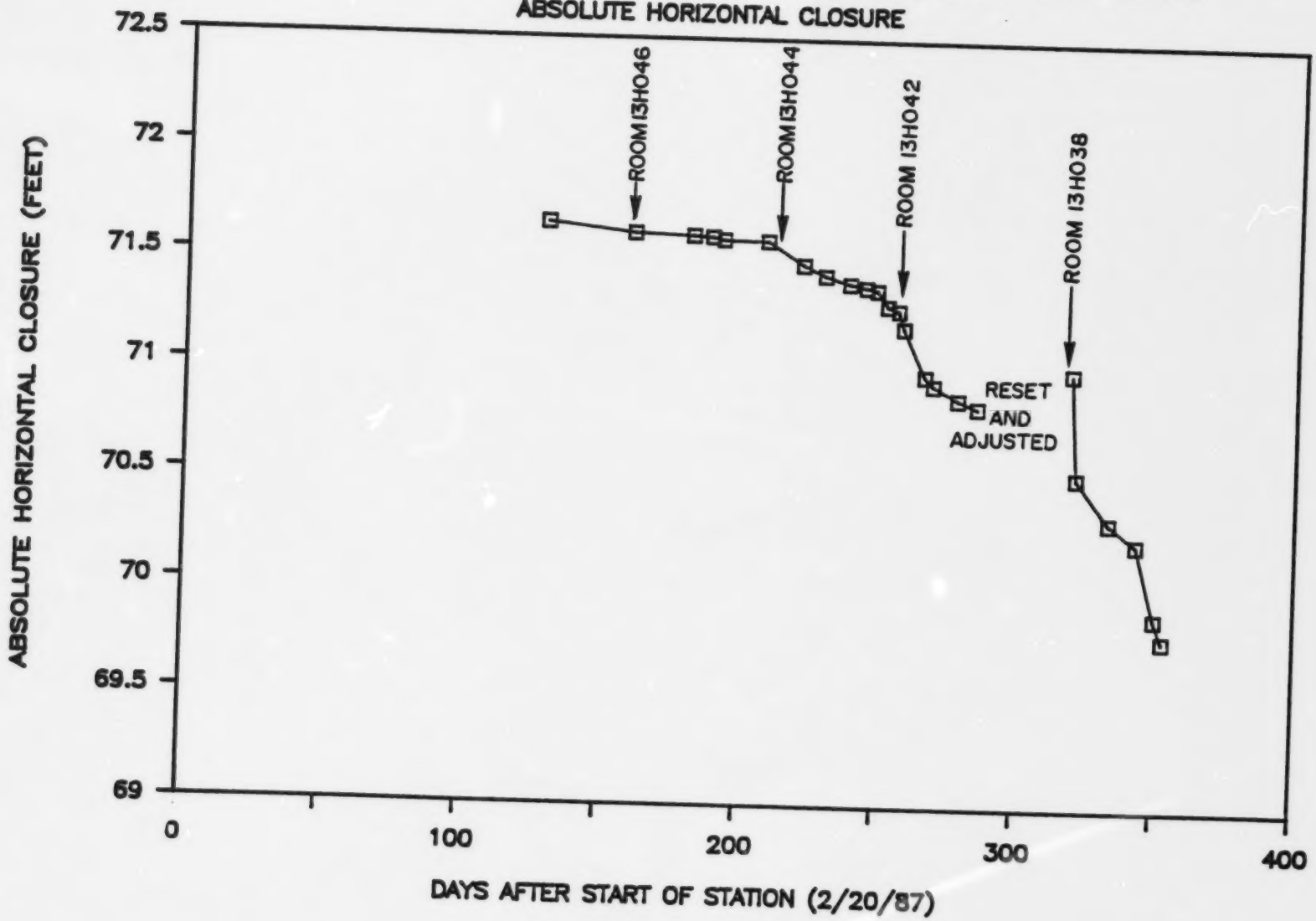


FIGURE 4.7

4.3 Roof Instrumentation

The following tables and figures record data for the roof instrumentation in Room 10H040.

TABLE 4.4

K-2 STATION, PANEL 13H, ROOM 13H040
ROOF 6-CHANNEL EXTENSOMETER

DATE	DAYS	CHANNEL 1 30 FT. ANCHOR		CHANNEL 2 25 FT. ANCHOR		CHANNEL 3 20 FT. ANCHOR		CHANNEL 4 15 FT. ANCHOR		CHANNEL 5 10 FT. ANCHOR		CHANNEL 6 5 FT. ANCHOR	
		READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)
20-Feb-87	0		0		0		0		0		0		0
12-Mar-87	20		0		0		0		0		0		0
27-Mar-87	35	0.0063	0.0000	0.0874	0.0000	0.2386	0.0000	0.4551	0.0000	0.4201	0.0000	0.0122	0.0000
01-Apr-87	40	0.0031	-0.0031	0.0843	-0.0031	0.2358	-0.0028	0.4524	-0.0028	0.4173	-0.0028		0.0000
08-Apr-87	47	0.0039	-0.0024	0.0874	0.0000	0.2378	-0.0008	0.4539	-0.0012	0.4193	-0.0008	0.0051	-0.0071
15-Apr-87	54	0.0024	-0.0039	0.0878	0.0004	0.2386	0.0000	0.4535	-0.0016	0.4173	-0.0028	0.0039	-0.0083
23-Apr-87	62	0.0067	0.0004	0.0957	0.0083	0.2461	0.0075	0.4591	0.0039	0.4220	0.0020	0.0083	-0.0039
28-Apr-87	67	0.0055	-0.0008	0.0972	0.0098	0.2468	0.0083	0.4587	0.0035	0.4213	0.0012	0.0063	-0.0059
06-May-87	75	0.0024	-0.0039	0.1008	0.0134	0.2472	0.0087	0.4583	0.0031	0.4201	0.0000	0.0035	-0.0087
15-May-87	84	0.0035	-0.0028	0.1071	0.0197	0.2512	0.0126	0.4610	0.0059	0.4217	0.0016	0.0051	-0.0071
22-May-87	91	0.0043	-0.0020	0.1134	0.0260	0.2539	0.0154	0.4626	0.0075	0.4244	0.0043	0.0063	-0.0059
04-Jun-87	104	0.0067	0.0004	0.1228	0.0354	0.2575	0.0189	0.4650	0.0098	0.4244	0.0043	0.0039	-0.0083
10-Jun-87	110	0.0157	0.0094	0.1303	0.0429	0.2626	0.0240	0.4689	0.0138	0.4264	0.0063	0.0039	-0.0083
16-Jun-87	116	0.0236	0.0173	0.1366	0.0492	0.2665	0.0280	0.4709	0.0157	0.4287	0.0087	0.0039	-0.0083
24-Jun-87	124	0.0335	0.0272	0.1441	0.0567	0.2713	0.0327	0.4740	0.0189	0.4295	0.0094	0.0039	-0.0083
13-Jul-87	143	0.0535	0.0472	0.1551	0.0677	0.2740	0.0354	0.4677	0.0126	0.4390	0.0189	0.0067	-0.0055
23-Jul-87	153	0.0567	0.0504	0.1626	0.0752	0.2831	0.0445	0.4772	0.0221	0.4343	0.0142	0.0035	-0.0087
27-Aug-87	188	0.1516	0.1453	0.2307	0.1433	0.3268	0.0882	0.5106	0.0555	0.4520	0.0319	0.0059	-0.0063
31-Aug-87	192	0.1520	0.1457	0.2268	0.1394	0.3201	0.0815	0.5000	0.0449	0.4413	0.0213	0.0028	-0.0094
11-Sep-87	203	0.1693	0.1630	0.2406	0.1531	0.3323	0.0937			0.4476	0.0276	0.0043	-0.0079
16-Sep-87	208	0.1535	0.1472	0.2094	0.1220	0.2831	0.0445	0.5512	0.0961	0.3772	-0.0429	0.0035	-0.0087
07-Oct-87	229	0.2504	0.2441	0.2980	0.2106	0.3587	0.1201			0.4417	0.0217		
16-Oct-87	238	0.2827	0.2764			0.3874	0.1488	0.5453	0.0902	0.4681	0.0480	0.0035	-0.0087
30-Oct-87	252	0.2417	0.2354	0.2705	0.1831	0.3154	0.0768	0.4374	-0.0177	0.3736	-0.0465	0.0020	-0.0102
02-Nov-87	255	0.3256	0.3193	0.3602	0.2728	0.4138	0.1752			0.4846	0.0646		
05-Nov-87	258	0.3772	0.3709	0.4012	0.3138	0.4461	0.2075			0.4984	0.0783		
10-Nov-87	263	0.4126	0.4063	0.4335	0.3461	0.4736	0.2350			0.5193	0.0992		
13-Nov-87	266	0.4228	0.4165	0.4425	0.3551	0.4803	0.2417			0.5193	0.0992		
16-Nov-87	269	0.4331	0.4268	0.4512	0.3638	0.4878	0.2492			0.5232	0.1031		
25-Nov-87	278	0.4512	0.4449	0.4642	0.3768	0.4968	0.2583			0.5283	0.1083		
02-Dec-87	285	0.4602	0.4539	0.4720	0.3846	0.5031	0.2646			0.5413	0.1213		
15-Dec-87	298	0.4823	0.4760	0.4878	0.4004	0.5134	0.2748	0.6425	0.1874	0.5366	0.1165	0.0031	-0.0091
18-Dec-87	301	0.5118	0.5055	0.5106	0.4232	0.5295	0.2909	0.6543	0.1992	0.5445	0.1244		
05-Jan-88	319	0.5173	0.5110	0.5142	0.4268	0.5331	0.2945	0.6571	0.2020	0.5468	0.1268		
07-Jan-88	321	0.7165	0.7102	0.6055	0.5181	0.6236	0.3850	0.7398	0.2846	0.6299	0.2098		
19-Jan-88	333	0.7638	0.7575	0.7398	0.6524	0.8307	0.5921	0.8646	0.4094	0.7425	0.3224		
29-Jan-88	343	0.7913	0.7850	0.7827	0.6953	0.8701	0.6315	0.8724	0.4173	0.7571	0.3370		
05-Feb-88	350	0.8291	0.8228	0.7874	0.7000	0.9008	0.6622	0.9063	0.4512	0.7913	0.3713		
08-Feb-88	353												

NOTES: (1) START OF STATION (20-FEB-87) IS USED AS COMMON REFERENCE POINT FOR PANEL 13H INSTRUMENTATION.
(2)"CUM. MOVEMENT" REFERS TO CUMULATIVE ANCHOR MOVEMENT RELATIVE TO COLLAR OF HOLE.

TABLE 4.5

K-2 STATION, PANEL 13H, ROOM 13H040
ROOF 6-CHANNEL EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 04-JUN-87 TO 23-JUL-87

	DATE	DAYS	CHANNEL 1 30 FT. ANCHOR	CHANNEL 2 25 FT. ANCHOR	CHANNEL 3 20 FT. ANCHOR	CHANNEL 4 15 FT. ANCHOR	CHANNEL 5 10 FT. ANCHOR	CHANNEL 6 5 FT. ANCHOR
			READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)
	04-Jun-87	104	0.0067	0.1228	0.2575	0.4650	0.4244	0.0039
	23-Jul-87	153	0.0567	0.1626	0.2831	0.4772	0.4343	0.0035
DIFFERENCE		49	0.0500	0.0398	0.0256	0.0122	0.0099	-0.0004
30 FT. - 25 FT. ANCHOR READING			0.0102					
AV. STRAIN RATE (SEC-1)			4.02E-11					
25 FT. - 20 FT. ANCHOR READING				0.0142				
AV. STRAIN RATE (SEC-1)				5.59E-11				
20 FT. - 15 FT. ANCHOR READING					0.0134			
AV. STRAIN RATE (SEC-1)					5.28E-11			
15 FT. - 10 FT. ANCHOR READING						0.0023		
AV. STRAIN RATE (SEC-1)						9.05E-12		
10 FT. - 5 FT. ANCHOR READING							0.0103	
AV. STRAIN RATE (SEC-1)							4.05E-11	
5 FT. - 0 FT. ANCHOR READING								-0.0004
AV. STRAIN RATE (SEC-1)								-1.57E-12

TABLE 4.6

K-2 STATION, PANEL 13H, ROOM 13H040
ROOF 6-CHANNEL EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 30-OCT-87 TO 18-DEC-87

	DATE	DAYS	CHANNEL 1 30 FT. ANCHOR	CHANNEL 2 25 FT. ANCHOR	CHANNEL 3 20 FT. ANCHOR	CHANNEL 4 15 FT. ANCHOR	CHANNEL 5 10 FT. ANCHOR	CHANNEL 6 5 FT. ANCHOR
			READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)
	30-Oct-87	252	0.2417	0.2705	0.3154	0.4374	0.3736	0.0020
	18-Dec-87	301	0.5118	0.5106	0.5295	0.6543	0.5445	0.0031
DIFFERENCE		49	0.2701	0.2401	0.2141	0.2169	0.1709	0.0011
30 FT. - 25 FT. ANCHOR READING			0.0300					
AV. STRAIN RATE (SEC-1)			1.18E-10					
25 FT. - 20 FT. ANCHOR READING				0.026				
AV. STRAIN RATE (SEC-1)				1.02E-10				
20 FT. - 15 FT. ANCHOR READING					-0.0028			
AV. STRAIN RATE (SEC-1)					-1.10E-11			
15 FT. - 10 FT. ANCHOR READING						0.0460		
AV. STRAIN RATE (SEC-1)						1.81E-10		
10 FT. - 5 FT. ANCHOR READING							0.1698	
AV. STRAIN RATE (SEC-1)							6.68E-10	
5 FT. - 0 FT. ANCHOR READING								0.0011
AV. STRAIN RATE (SEC-1)								4.33E-12

K–2 STATION, PANEL 13H, ROOM 13H040

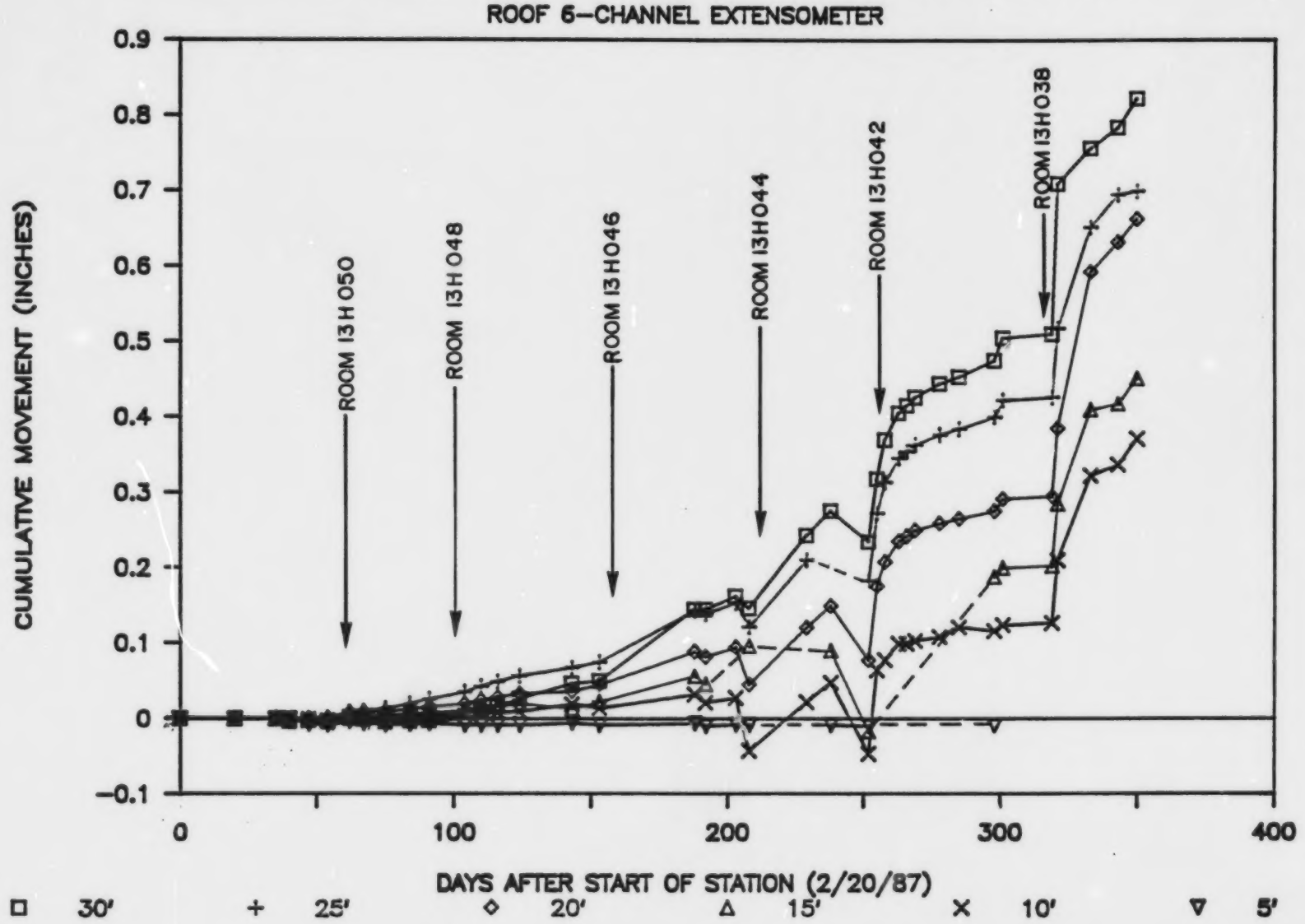


FIGURE 4.8

TABLE 4.7

K-2 STATION, PANEL 13H, ROOM 13H040
ROOF TANGENTIAL PRESSURE AT 10 FOOT DEPTH

DATE	DAYS	PRESSURE 10' (PSI)
20-Feb-87	0	
01-Apr-87	40	3000
08-Apr-87	47	2820
15-Apr-87	54	2680
23-Apr-87	62	2570
28-Apr-87	67	2510
06-May-87	75	2430
15-May-87	84	2390
22-May-87	91	2310
29-May-87	98	2280
04-Jun-87	104	2280
10-Jun-87	110	2250
16-Jun-87	116	2250
19-Jun-87	119	2200
24-Jun-87	124	2190
29-Jun-87	129	2150
13-Jul-87	143	2110
30-Jul-87	160	2100
20-Aug-87	181	2050
27-Aug-87	188	2020
31-Aug-87	192	2010
11-Sep-87	203	2010
16-Sep-87	208	2000
29-Sep-87	221	1990
07-Oct-87	229	1990
16-Oct-87	238	1920
26-Oct-87	248	1910
27-Oct-87	249	1920
30-Oct-87	252	1920
02-Nov-87	255	1950
05-Nov-87	258	1910
10-Nov-87	263	1890
13-Nov-87	266	1900
16-Nov-87	269	1890
25-Nov-87	278	1890
02-Dec-87	285	1840
15-Dec-87	298	1825
18-Dec-87	301	1800
05-Jan-88	319	1770
07-Jan-88	321	1760
19-Jan-88	333	1775
29-Jan-88	343	1750
05-Feb-88	350	1750
08-Feb-88	353	

K-2 STATION, PANEL 13H, ROOM 13H040

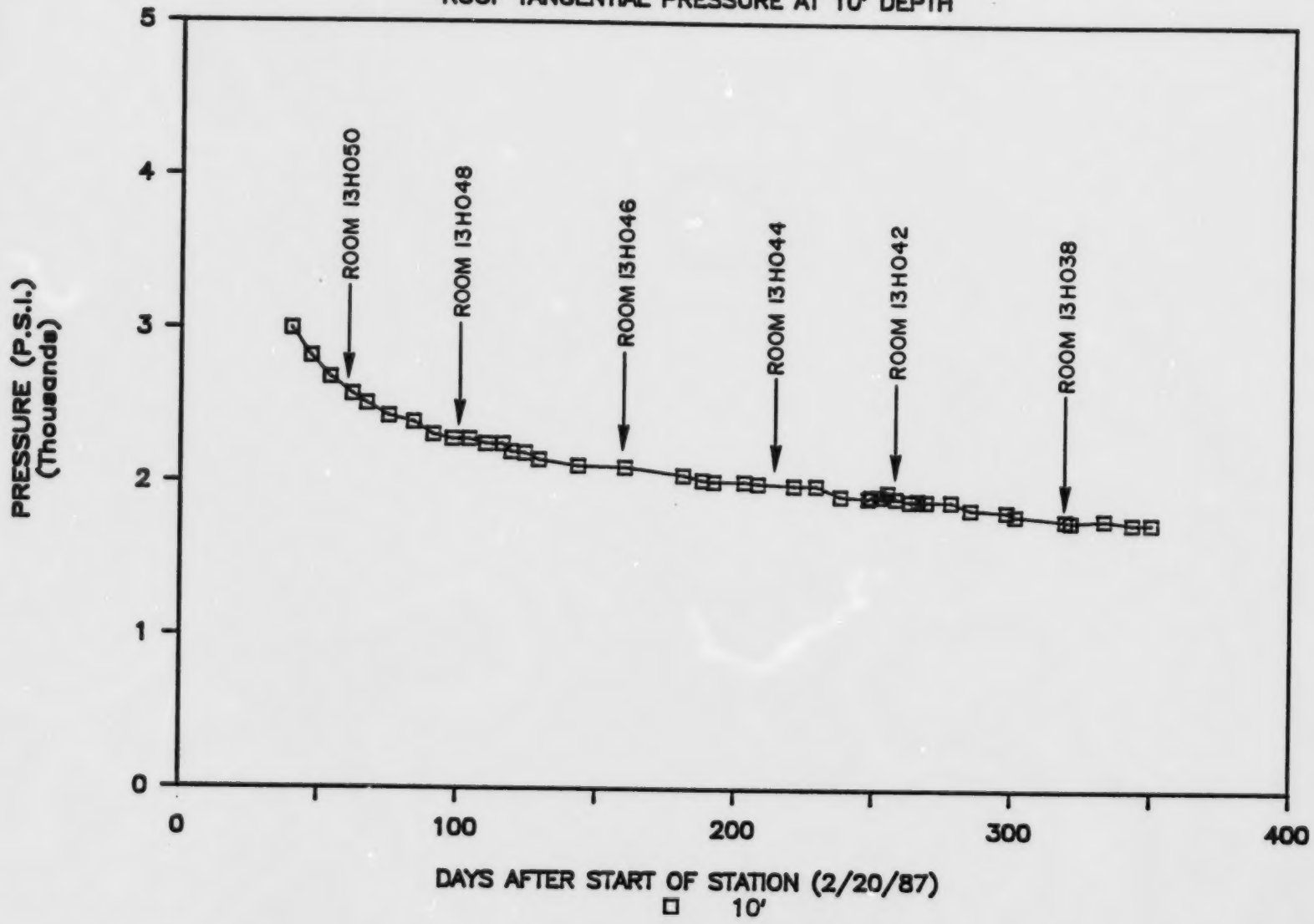


FIGURE 4.9

4.4 Floor Instrumentation

The following tables and figures record data for the floor instrumentation in Room 10H040.

TABLE 4.8

K-2 STATION, PANEL 13H, ROOM 13H040
FLOOR ROD AND PLATE EXTENSOMETER

		30 FT. ANCHOR		20 FT. ANCHOR		10 FT. ANCHOR	
DATE	DAYS	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)
20-Feb-87	0	0	0	0	0	0	0
12-Mar-87	20	1.158	0.000	1.000	0.000	0.990	0.000
27-Mar-87	35	1.170	0.012	1.015	0.015	0.997	0.007
01-Apr-87	40	1.175	0.017	1.018	0.018	1.000	0.010
08-Apr-87	47	1.178	0.020	1.024	0.024	1.001	0.011
15-Apr-87	54	1.183	0.025	1.027	0.027	1.002	0.012
23-Apr-87	62	1.189	0.031	1.034	0.034	1.006	0.016
28-Apr-87	67	1.196	0.038	1.039	0.039	1.008	0.018
06-May-87	75	1.207	0.049	1.048	0.048	1.012	0.022
15-May-87	84	1.219	0.061	1.057	0.057	1.016	0.026
22-May-87	91	1.228	0.070	1.063	0.063	1.019	0.029
04-Jun-87	104	1.227	0.069	1.079	0.079	1.028	0.038
10-Jun-87	110	1.265	0.107	1.091	0.091	1.031	0.041
16-Jun-87	116	1.280	0.122	1.102	0.102	1.036	0.046
24-Jun-87	124	1.298	0.140	1.114	0.114	1.041	0.051
13-Jul-87	143	1.333	0.175	1.137	0.137	1.053	0.063
23-Jul-87	153	1.350	0.192	1.148	0.148	1.058	0.068
20-Aug-87	181	1.464	0.306	1.221	0.221	1.091	0.101
27-Aug-87	188	1.500	0.342	1.243	0.243	1.102	0.112
31-Aug-87	192	1.510	0.352	1.250	0.250	1.105	0.115
11-Sep-87	203	1.545	0.387	1.274	0.274	1.117	0.127
16-Sep-87	208	1.562	0.404	1.285	0.285	1.121	0.131
29-Sep-87	221	1.655	0.497	1.350	0.350	1.155	0.165
07-Oct-87	229	1.709	0.551	1.389	0.389	1.174	0.184
16-Oct-87	238	1.744	0.586	1.412	0.412	1.186	0.196
22-Oct-87	244	1.766	0.608	1.429	0.429	1.195	0.205
26-Oct-87	248	1.785	0.627	1.441	0.441	1.201	0.211
30-Oct-87	252	1.796	0.638	1.448	0.448	1.205	0.215
02-Nov-87	255	1.819	0.661	1.464	0.464	1.213	0.223
05-Nov-87	258	1.892	0.734	1.517	0.517	1.241	0.251
10-Nov-87	263	1.947	0.789	1.569	0.569	1.274	0.284
13-Nov-87	266	2.027	0.869	1.587	0.587	1.285	0.295
16-Nov-87	269	2.044	0.886	1.601	0.601	1.293	0.303
25-Nov-87	278	2.083	0.925	1.631	0.631	1.311	0.321
02-Dec-87	285	2.104	0.946	1.648	0.648	1.321	0.331
18-Dec-87	301	2.082	0.924	1.679	0.679	1.339	0.349
05-Jan-88	319	2.141	0.983	1.720	0.720	1.352	0.362
07-Jan-88	321	2.157	0.999	1.731	0.731	1.368	0.378
19-Jan-88	333	2.158	1.000	1.763	0.763	1.393	0.403
29-Jan-88	343	2.163	1.005	1.755	0.755	1.375	0.385
05-Feb-88	350	2.183	1.025	1.767	0.767	1.382	0.392
08-Feb-88	353	2.200	1.042	1.774	0.774	1.387	0.397

NOTES: (1) START OF STATION (20-FEB-87) IS USED AS COMMON REFERENCE POINT FOR PANEL 13H INSTRUMENTATION.
(2) "CUM. MOVEMENT" REFERS TO CUMULATIVE ANCHOR MOVEMENT RELATIVE TO COLLAR OF HOLE.

TABLE 4.9

K-2 STATION, PANEL 13H, ROOM 13H040
FLOOR ROD AND PLATE EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 04-JUN-87 TO 23-JUL-87

	DATE	DAYS	30 FT. ANCHOR	20 FT. ANCHOR	10 FT. ANCHOR
			CUMULATIVE MOVEMENT (INS.)	CUMULATIVE MOVEMENT (INS.)	CUMULATIVE MOVEMENT (INS.)
	04-Jun-87	104	1.227	1.079	1.028
	23-Jul-87	153	1.350	1.148	1.058
DIFFERENCE		49	0.123	0.069	0.030
30 FT. - 20 FT. ANCHOR READING			0.054		
AV. STRAIN RATE (SEC-1)			1.06E-10		
20 FT. - 10 FT. ANCHOR READING				0.039	
AV. STRAIN RATE (SEC-1)				7.68E-11	
10 FT. - 0 FT. ANCHOR READING					0.0300
AV. STRAIN RATE (SEC-1)					5.91E-11

TABLE 4.10

K-2 STATION, PANEL 13H, ROOM 13H040
FLOOR ROD AND PLATE EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 30-OCT-87 TO 18-DEC-87

	DATE	DAYS	30 FT. ANCHOR	20 FT. ANCHOR	10 FT. ANCHOR
			CUMULATIVE MOVEMENT (INS.)	CUMULATIVE MOVEMENT (INS.)	CUMULATIVE MOVEMENT (INS.)
	30-Oct-87	252	1.796	1.448	1.205
	18-Dec-87	301	2.082	1.679	1.339
DIFFERENCE		49	0.286	0.231	0.134
30 FT. - 20 FT. ANCHOR READING			0.055		
AV. STRAIN RATE (SEC-1)			1.08E-10		
20 FT. - 10 FT. ANCHOR READING				0.097	
AV. STRAIN RATE (SEC-1)				1.91E-10	
10 FT. - 0 FT. ANCHOR READING					0.134
AV. STRAIN RATE (SEC-1)					2.64E-10

K-2 STATION, PANEL 13H, ROOM 13H040

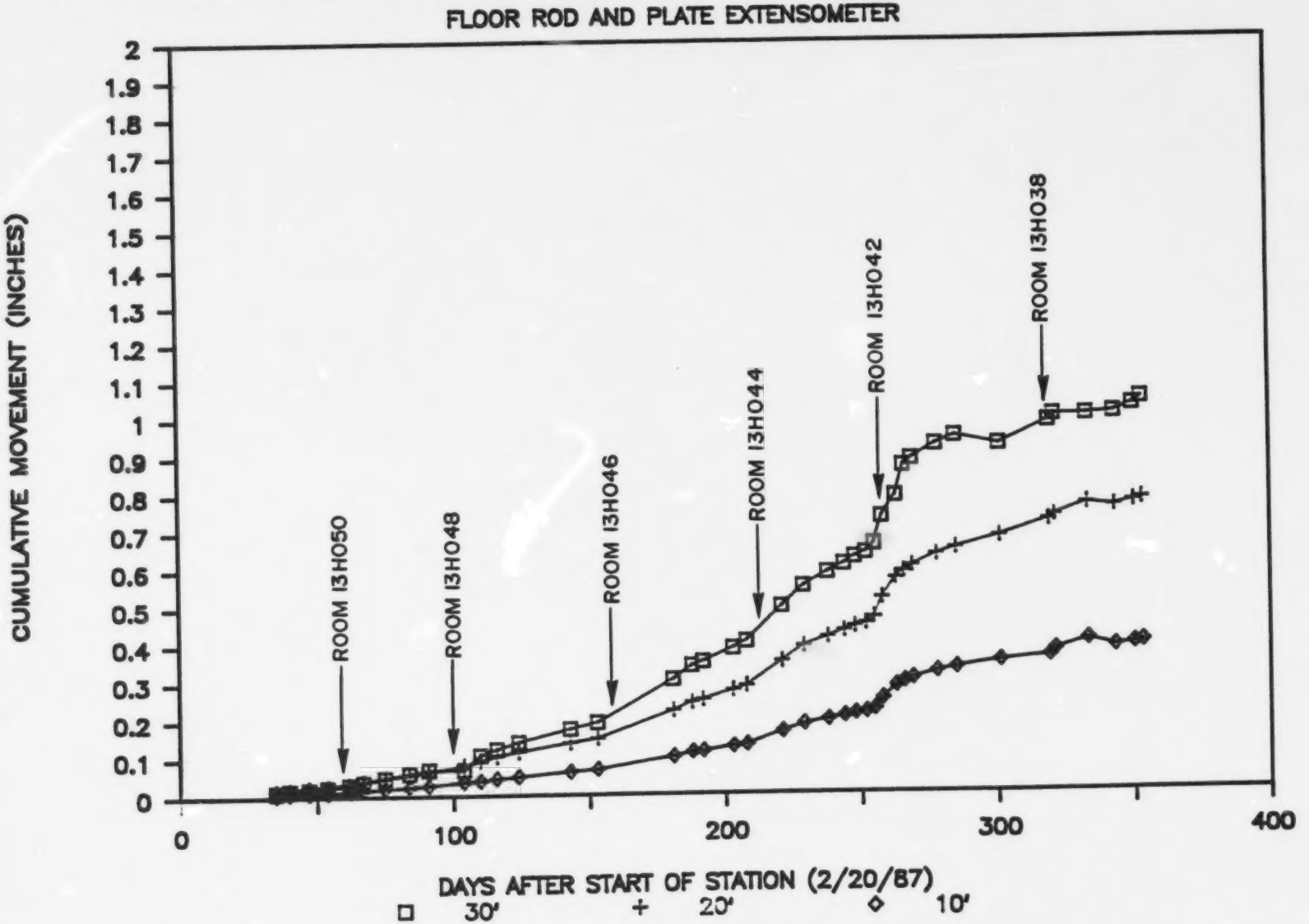


FIGURE 4.10

4.5 Large (South) Pillar Instrumentation

The following tables and figures record data for the large (south) pillar instrumentation in Room 13H040.

TABLE 4.11

K-2 STATION, PANEL 13H, ROOM 13H040
LARGE (SOUTH) PILLAR 6-CHANNEL EXTENSOMETER

DATE	DAYS	CHANNEL 1 30 FT. ANCHOR		CHANNEL 2 25 FT. ANCHOR		CHANNEL 3 20 FT. ANCHOR		CHANNEL 4 15 FT. ANCHOR		CHANNEL 5 10 FT. ANCHOR		CHANNEL 6 5 FT. ANCHOR	
		READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)
20-Feb-87	0		0		0		0		0		0		0
27-Mar-87	35	0.0043	0.000	0.3953	0.000	0.1642	0.000	0.0067	0.000	0.0051	0.000	0.0555	0.000
01-Apr-87	40	0.0028	-0.002	0.4012	0.006	0.1657	0.002	0.0051	-0.002	0.0039	-0.001	0.0244	-0.031
08-Apr-87	47	0.0110	0.007	0.4094	0.014	0.1764	0.012	0.0114	0.005	0.0110	0.006	0.0339	-0.022
15-Apr-87	54	0.0197	0.015	0.4193	0.024	0.1858	0.022	0.0161	0.009	0.0197	0.015	0.0433	-0.012
23-Apr-87	62	0.0370	0.033	0.4358	0.041	0.2031	0.039	0.0283	0.022	0.0366	0.031	0.0602	0.005
28-Apr-87	67	0.0563	0.052	0.4539	0.059	0.2209	0.057	0.0429	0.036	0.0551	0.050	0.0795	0.024
06-May-87	75	0.0650	0.061	0.4618	0.067	0.2283	0.064	0.0437	0.037	0.0634	0.058	0.0882	0.033
15-May-87	84	0.0886	0.084	0.4835	0.088	0.2496	0.085	0.0591	0.052	0.0862	0.081	0.1110	0.056
22-May-87	91	0.1031	0.099	0.4980	0.103	0.2606	0.096	0.0665	0.060	0.1016	0.096	0.1260	0.070
04-Jun-87	104	0.1346	0.130	0.5264	0.131	0.2898	0.126	0.0850	0.078	0.1406	0.135	0.1571	0.102
10-Jun-87	110	0.1547	0.150	0.5468	0.152	0.3091	0.145	0.0992	0.093	0.1406	0.135	0.1772	0.122
16-Jun-87	116	0.1776	0.173	0.5685	0.173	0.3287	0.165	0.1134	0.107	0.1406	0.135	0.2004	0.145
24-Jun-87	124	0.2043	0.200	0.5937	0.198	0.3520	0.188	0.1299	0.123	0.1406	0.135	0.2248	0.169
13-Jul-87	143	0.2728	0.269	0.6547	0.259	0.4067	0.243	0.1693	0.163	0.1457	0.141	0.2760	0.220
23-Jul-87	153	0.2843	0.280	0.6689	0.274	0.4177	0.254	0.1937	0.187	0.1406	0.135	0.3047	0.249
27-Aug-87	188	0.4417	0.437	0.8252	0.430	0.5579	0.394	0.2791	0.272	0.1390	0.134	0.4614	0.406
31-Aug-87	192	0.4579	0.454	0.8429	0.448	0.5732	0.409	0.3004	0.294	0.1398	0.135	0.4772	0.422
11-Sep-87	203	0.5106	0.506			0.6224	0.458	0.3236	0.317	0.1425	0.137	0.5272	0.472
16-Sep-87	208	0.5323	0.528	0.9181	0.523	0.6429	0.479	0.3370	0.330	0.1413	0.136	0.5492	0.494
07-Oct-87	229			1.1563	0.761	0.8764	0.712	0.4980	0.491	0.1406	0.135	0.8012	0.746
30-Oct-87	252	0.8398	0.835	1.1571	0.762	0.8882	0.724	0.5205	0.514	0.1260	0.121	0.8421	0.787
02-Nov-87	255	0.9685	0.964	1.3205	0.925	1.0181	0.854	0.6024	0.596	0.1398	0.135	0.9693	0.914
05-Nov-87	258	1.0512	1.047	1.4051	1.010	1.0949	0.931	0.6638	0.657	0.1402	0.135	1.0520	0.996
10-Nov-87	263	1.3118	1.307	1.6602	1.265	1.3697	1.206	0.8547	0.848	0.1402	0.135	1.3165	1.261
13-Nov-87	266	1.4165	1.412	1.7571	1.362	1.4339	1.270	0.9209	0.914	0.1402	0.135	1.4224	1.367
16-Nov-87	269	1.4862	1.482	1.8276	1.432	1.4996	1.335	0.9697	0.963	0.1402	0.135		
25-Nov-87	278	1.6236	1.619	1.9669	1.572	1.6268	1.463	1.0654	1.059	0.1402	0.135	1.6279	1.572
02-Dec-87	285	1.7102	1.706	2.0417	1.646	1.6882	1.524	1.1063	1.100	0.1402	0.135	1.7150	1.659
15-Dec-87	298	1.8890	1.885	2.2016	1.806	1.8350	1.671	1.1756	1.169			1.8858	1.830
18-Dec-87	301	2.1453	2.141	2.4575	2.062	2.0701	1.906	1.3433	1.337	0.2496	0.244	2.1468	2.091
05-Jan-88	319	2.4681	2.464	2.7657	2.370	2.3445	2.180	1.5405	1.534	0.4992	0.494	2.4500	2.394
07-Jan-88	321	2.8173	2.813	3.1811	2.786	2.7642	2.600	1.7689	1.762			2.7701	2.715
19-Jan-88	333	2.9409	2.937	3.3252	2.930	2.9279	2.764	1.8988	1.892	0.7618	0.757	2.8937	2.838
29-Jan-88	343	3.0146	3.010	3.3894	2.994	2.9961	2.832	1.9606	1.954	0.8272	0.822	2.9567	2.901
05-Feb-88	350	3.0492	3.045	3.4256	3.030	3.0354	2.871	1.9961	1.989	0.8626	0.857	2.9917	2.936
08-Feb-88	353												

NOTES: (1) START OF STATION (20-FEB-87) IS USED AS COMMON REFERENCE POINT FOR PANEL 13H INSTRUMENTATION.
(2) "CUM. MOVEMENT" REFERS TO CUMULATIVE ANCHOR MOVEMENT RELATIVE TO COLLAR OF HOLE.

TABLE 4.12

K-2 STATION, PANEL 13H, ROOM 13H040
LARGE (SOUTH) PILLAR 6-CHANNEL EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 04-JUN-87 TO 23-JUL-87

	DATE	DAYS	CHANNEL 1 30 FT. ANCHOR	CHANNEL 2 25 FT. ANCHOR	CHANNEL 3 20 FT. ANCHOR	CHANNEL 4 15 FT. ANCHOR	CHANNEL 5 10 FT. ANCHOR	CHANNEL 6 5 FT. ANCHOR
			READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)
	04-Jun-87	104	0.1346	0.5264	0.2898	0.0850	0.1406	0.1571
	23-Jul-87	153	0.2843	0.6689	0.4177	0.1937	0.1406	0.3047
DIFFERENCE		49	0.1497	0.1425	0.1279	0.1087	0.0000	0.1476
30 FT. - 25 FT. ANCHOR READING			0.0072					
AV. STRAIN RATE (SEC-1)			2.83E-11					
25 FT. - 20 FT. ANCHOR READING				0.0146				
AV. STRAIN RATE (SEC-1)				5.75E-11				
20 FT. - 15 FT. ANCHOR READING					0.0192			
AV. STRAIN RATE (SEC-1)					7.56E-11			
15 FT. - 10 FT. ANCHOR READING						0.1087		
AV. STRAIN RATE (SEC-1)						4.28E-10		
10 FT. - 5 FT. ANCHOR READING							-0.1476	
AV. STRAIN RATE (SEC-1)							-5.81E-10	
5 FT. - 0 FT. ANCHOR READING								0.1476
AV. STRAIN RATE (SEC-1)								5.81E-10

TABLE 4.13

K-2 STATION, PANEL 13H, ROOM 13H040
LARGE (SOUTH) PILLAR 6-CHANNEL EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 30-OCT-87 TO 18-DEC-87

	DATE	DAYS	CHANNEL 1 30 FT. ANCHOR	CHANNEL 2 25 FT. ANCHOR	CHANNEL 3 20 FT. ANCHOR	CHANNEL 4 15 FT. ANCHOR	CHANNEL 5 10 FT. ANCHOR	CHANNEL 6 5 FT. ANCHOR
			READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)	READING (INS.)
	30-Oct-87	252	0.8398	1.1571	0.8882	0.5205	0.1260	0.8421
	18-Dec-87	301	2.1453	2.4575	2.0701	1.3433	0.2496	2.1468
DIFFERENCE		49	1.3055	1.3004	1.1819	0.8228	0.1236	1.3047
30 FT. - 25 FT. ANCHOR READING			0.0051					
AV. STRAIN RATE (SEC-1)			2.01E-11					
25 FT. - 20 FT. ANCHOR READING				0.1185				
AV. STRAIN RATE (SEC-1)				4.67E-10				
20 FT. - 15 FT. ANCHOR READING					0.3591			
AV. STRAIN RATE (SEC-1)					1.41E-09			
15 FT. - 10 FT. ANCHOR READING						0.6992		
AV. STRAIN RATE (SEC-1)						2.75E-09		
10 FT. - 5 FT. ANCHOR READING							-1.1811	
AV. STRAIN RATE (SEC-1)							-4.65E-09	
5 FT. - 0 FT. ANCHOR READING								1.3047
AV. STRAIN RATE (SEC-1)								5.14E-09

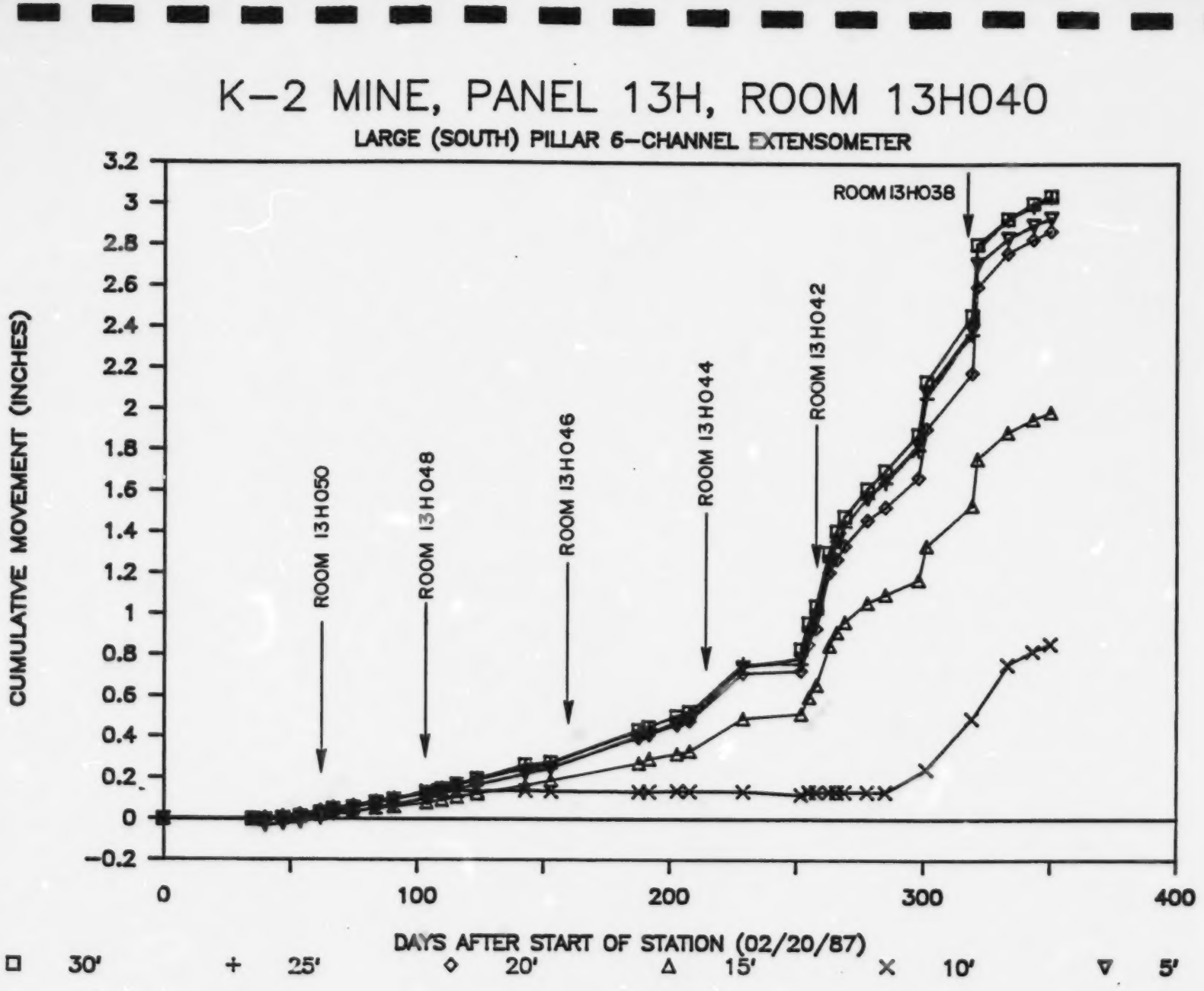

K–2 MINE, PANEL 13H, ROOM 13H040
LARGE (SOUTH) PILLAR 6–CHANNEL EXTENSOMETER
CUMULATIVE MOVEMENT (INCHES)
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
–0.2
ROOM 13H050
ROOM 13H048
ROOM 13H046
ROOM 13H044
ROOM 13H042
ROOM 13H038
0
100
200
300
400
DAYS AFTER START OF STATION (02/20/87)
□ 30'
+ 25'
◇ 20'
△ 15'
× 10'
▽ 5'

FIGURE 4.11 .

TABLE 4.14

K-2 STATION, PANEL 13H, ROOM 13H040
LARGE (SOUTH) PILLAR RADIAL PRESSURE

DATE	DAYS	PRESSURE 25' (PSI)	PRESSURE 20' (PSI)	PRESSURE 15' (PSI)	PRESSURE 10' (PSI)	PRESSURE 5' (PSI)
20-Feb-87	0					
23-Apr-87	62	1390	1950	1900	1900	0
28-Apr-87	67	1400	1800	1900	1100	0
06-May-87	75	1390	1680	1900	750	0
15-May-87	84	1390	1600	1900	1000	0
22-May-87	91	1300	1590	1950	1290	0
29-May-87	98	1319	1575	2000	1450	0
04-Jun-87	104	1210	1590	2020	1510	0
10-Jun-87	110	1300	1620	2100	875	0
19-Jun-87	119	1120	1650	2160	820	0
24-Jun-87	124	1220	1700	2200	800	0
29-Jun-87	129	1250	1675	2200	700	0
13-Jul-87	143	1350	1700	2250	1000	0
23-Jul-87	153	1350	1700	2250	500	0
30-Jul-87	160	1390	1705	2290	460	0
13-Aug-87	174	1510	1850	2430	560	0
20-Aug-87	181	1650	1950	2550	700	0
27-Aug-87	188	1750	2000	2600	700	0
31-Aug-87	192	1500	2000	2600	700	0
11-Sep-87	203	1620	2000	2610	700	0
16-Sep-87	208	1700	2020	2690	650	0
29-Sep-87	221	1850	2230	2910	950	0
07-Oct-87	229	-	2350	2990	950	0
16-Oct-87	238	-	2400	3000	1000	0
22-Oct-87	244	-	2400	3000	1200	0
26-Oct-87	248	-	2400	2980	1100	0
30-Oct-87	252	-	2400	3000	900	0
02-Nov-87	255	3910	2500	3100	1100	0
05-Nov-87	258	4130	2650	3250	1350	0
10-Nov-87	263	4520	2900	3470	1820	0
13-Nov-87	266	4730	3000	3500	1400	0
16-Nov-87	269	4590	3050	3500	1720	0
25-Nov-87	278	4490	3150	3530	2260	0
02-Dec-87	285	4230	3220	3550	2390	0
15-Dec-87	298	4110	3310	3600	2505	0
18-Dec-87	301	3980	3350	3600	2600	0
05-Jan-88	319	4000	3700	3800	3000	0
07-Jan-88	321	-	3850	3900	3300	0
19-Jan-88	333	-	4080	4150	3425	0
29-Jan-88	343	-	4100	4210	3190	0
05-Feb-88	350	-	4120	4250	3200	0
08-Feb-88	353	-	4150	4250	3225	0

K–2 STATION, PANEL 13H, ROOM 13H040

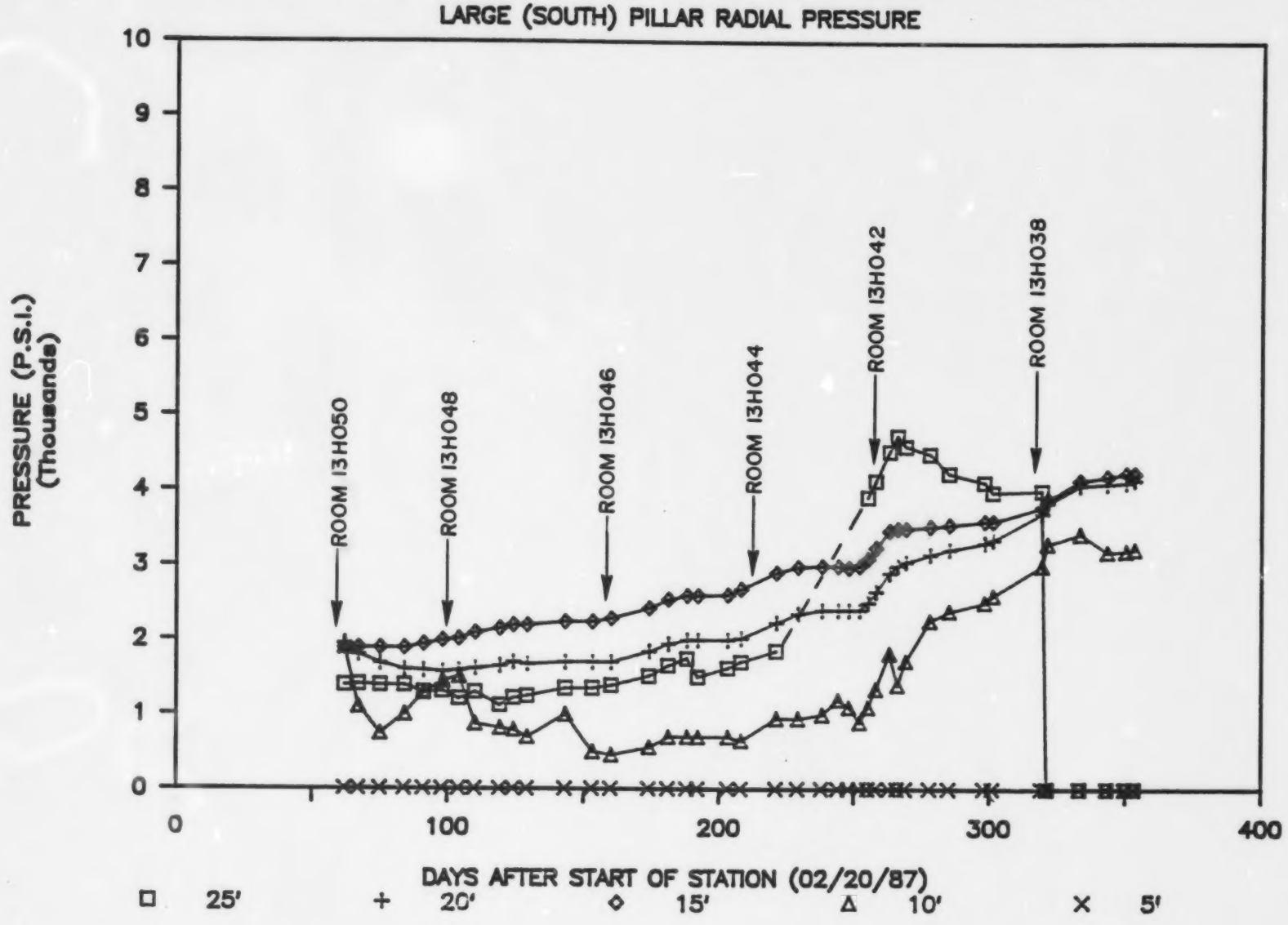


FIGURE 4.12

TABLE 4.15

K-2 STATION, PANEL 13H, ROOM 13H040
LARGE (SOUTH) PILLAR TANGENTIAL PRESSURE

DATE	DAYS	PRESSURE 25' (PSI)	PRESSURE 20' (PSI)	PRESSURE 15' (PSI)	PRESSURE 10' (PSI)	PRESSURE 5' (PSI)
20-Feb-87	0					
12-Mar-87	20	3850	4150	3750	3800	3800
27-Mar-87	35	3480	3690	3520	3220	3430
01-Apr-87	40	3420	3590	3490	3200	3380
08-Apr-87	47	3330	3500	3490	3200	3300
15-Apr-87	54	3270	3430	3490	3200	3120
23-Apr-87	62	3270	0	3510	3250	3190
28-Apr-87	67	3200	0	3550	3300	3190
06-May-87	75	3190	0	3590	3350	3190
15-May-87	84	3190	0	3600	3390	3190
22-May-87	91	2930	0	3630	3400	3250
29-May-87	98	2950	0	3680	3450	3250
04-Jun-87	104	2880	0	3720	3510	3380
10-Jun-87	110	2900	0	3790	3600	3400
19-Jun-87	119	2910	0	3820	3670	3450
24-Jun-87	124	2910	0	3840	3690	3460
29-Jun-87	129	2925	0	3975	3700	3475
13-Jul-87	143	2910	0	3870	3700	3410
23-Jul-87	153	2920	0	3870	3710	3400
30-Jul-87	160	2980	0	3890	3720	3400
13-Aug-87	174	3000	0	4050	4010	3470
20-Aug-87	181	3060	0	4190	4200	3510
27-Aug-87	188	3100	0	4240	4240	3620
31-Aug-87	192	3100	0	4250	4250	3700
11-Sep-87	203	3110	0	4340	4300	3660
16-Sep-87	208	3170	0	4390	4360	3660
29-Sep-87	221	3390	0	4710	4850	3990
07-Oct-87	229	3490	0	4920	4920	3790
16-Oct-87	238	3500	0	4880	4950	3750
22-Oct-87	244	3500	0	4910	4930	3750
26-Oct-87	248	3500	0	4940	4950	3850
30-Oct-87	252	3540	0	4990	4990	3750
02-Nov-87	255	3620	0	5080	5150	3950
05-Nov-87	258	3850	0	5220	5410	4390
10-Nov-87	263	4030	0	5500	5840	4390
13-Nov-87	266	4230	0	5550	5900	3850
16-Nov-87	269	4170	0	5600	5910	3800
25-Nov-87	278	3820	0	5650	5900	3300
02-Dec-87	285	2890	0	5690	5880	3390
15-Dec-87	298	2600	0	5710	5830	3250
18-Dec-87	301	2600	0	5750	5850	4200

TABLE 4.15 (CONTINUED)

K-2 STATION, PANEL 13H, ROOM 13H040
LARGE (SOUTH) PILLAR TANGENTIAL PRESSURE

DATE	DAYS	PRESSURE 25' (PSI)	PRESSURE 20' (PSI)	PRESSURE 15' (PSI)	PRESSURE 10' (PSI)	PRESSURE 5' (PSI)
05-Jan-88	319	2550	0	6020	6190	3750
07-Jan-88	321	3200	0	6300	6600	4200
19-Jan-88	333		0	6410	6500	4125
29-Jan-88	343	3400	0	6425	6400	3150
05-Feb-88	350		0	6410	6300	3000
08-Feb-88	353		0	6410	6500	2700

K–2 STATION, PANEL 13H, ROOM 13H040

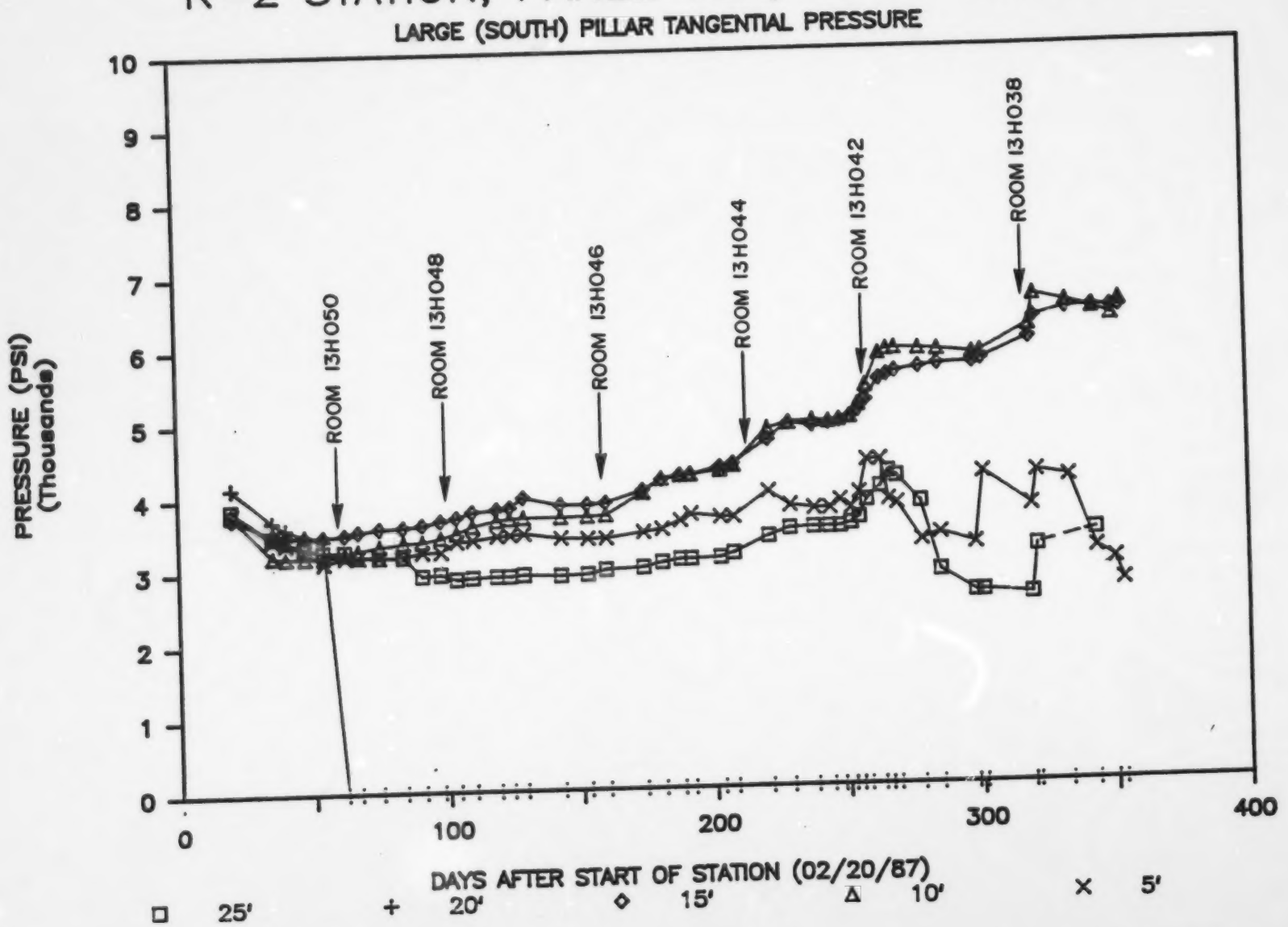


FIGURE 4.13

TABLE 4.16

K-2 STATION, PANEL 13H, ROOM 13H040
LARGE (SOUTH) PILLAR LATERAL PRESSURE

DATE	DAYS	PRESSURE 25' (PSI)	PRESSURE 20' (PSI)	PRESSURE 15' (PSI)	PRESSURE 10' (PSI)	PRESSURE 5' (PSI)
20-Feb-87	0					
12-Mar-87	20		3880		3950	3490
27-Mar-87	35		3320		3690	3180
01-Apr-87	40		3240		3640	3140
08-Apr-87	47	2850	3150		3620	3120
15-Apr-87	54	2620	3060		3610	3100
23-Apr-87	62	2490	3010	400	3620	3150
28-Apr-87	67	2430	2990	450	3680	3200
06-May-87	75	2350	2930	550	3700	3230
15-May-87	84	2300	2900	620	3700	3220
22-May-87	91	2250	2900	700	3710	3210
29-May-87	98	2210	2890	790	3750	3250
04-Jun-87	104	2170	2890	850	3790	3350
10-Jun-87	110	2200	2900	950	3810	3410
19-Jun-87	119	2200	2950	1050	3870	3450
24-Jun-87	124	2200	2940	1150	3890	3450
29-Jun-87	129	2200	2950	1175	3875	3450
13-Jul-87	143	2190	2970	1270	3890	3400
23-Jul-87	153	2190	2980	1250	3890	3400
30-Jul-87	160	2170	2990	1280	3880	3390
13-Aug-87	174	2250	3090	1500	4010	3630
20-Aug-87	181	2300	3160	1650	4150	3750
27-Aug-87	188	2350	3200	1790	4180	3730
31-Aug-87	192	2350	3220	1800	4170	3700
11-Sep-87	203	2380	3260	1920	4160	3680
16-Sep-87	208	2390	3300	2000	3630	3690
29-Sep-87	221	2550	3490	2320	4240	4200
07-Oct-87	229	2610	3550	3550	4330	4200
16-Oct-87	238	2670	3590	2550	4350	3990
22-Oct-87	244	2700	3600	2570	4320	3910
26-Oct-87	248	2700	3610	2600	4310	3890
30-Oct-87	252	2710	3650	2650	4350	3910
02-Nov-87	255	2800	3700	2750	4480	4130
05-Nov-87	258	2850	3790	2930	4680	4520
10-Nov-87	263	3050	4000	3320	5020	4730
13-Nov-87	266	3140	4020	3420	5100	4590
16-Nov-87	269	3200	4050	3490	5100	4490
25-Nov-87	278	3300	4110	3520	5090	4230
02-Dec-87	285	3350	4140	3550	5010	4110
15-Dec-87	298	3400	4160	3550	5000	3980
18-Dec-87	301	3400	4190	3580	5010	4000

TABLE 4.16 (CONTINUED)

K-2 STATION, PANEL 13H, ROOM 13H040
LARGE (SOUTH) PILLAR LATERAL PRESSURE

DATE	DAYS	PRESSURE 25' (PSI)	PRESSURE 20' (PSI)	PRESSURE 15' (PSI)	PRESSURE 10' (PSI)	PRESSURE 5' (PSI)
05-Jan-88	319	3660	4340	3870	5210	0
07-Jan-88	321	3990	4500	4010	5500	0
19-Jan-88	333	4200	4700	4110	5500	0
29-Jan-88	343	4275	4725	4100	5350	0
05-Feb-88	350	4320	4750	4100	5300	0
08-Feb-88	353	4450	4780	4110	5500	0

K-2 STATION, PANEL 13H, ROOM 13H040

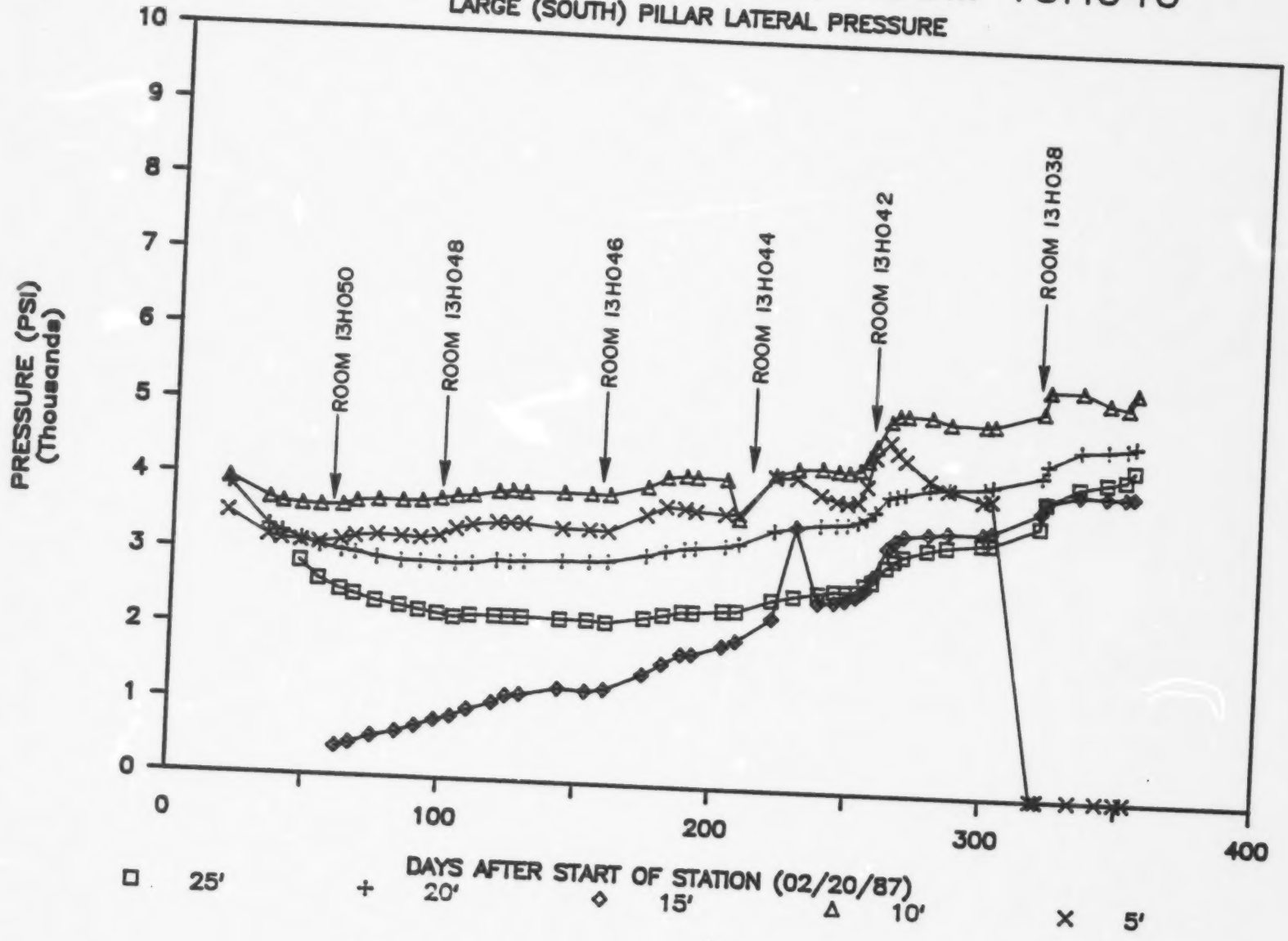


FIGURE 4.14

4.6 Small (North) Pillar Instrumentation

The following tables and figures record data for the small (north) pillar instrumentation in Room 13H040.

TABLE 4.17

K-2 STATION, PANEL 13H, ROOM 13H040
SMALL (NORTH) PILLAR TANGENTIAL PRESSURE

DATE	DAYS	PRESSURE 15' (PSI)
20-Feb-87	0	
12-Mar-87	20	
27-Mar-87	35	
01-Apr-87	40	
08-Apr-87	47	2490
15-Apr-87	54	2490
23-Apr-87	62	2490
28-Apr-87	67	2550
06-May-87	75	2610
15-May-87	84	2670
22-May-87	91	2700
29-May-87	98	2750
04-Jun-87	104	2920
10-Jun-87	110	2910
19-Jun-87	119	3010
24-Jun-87	124	3050
29-Jun-87	129	3075
13-Jul-87	143	3150
23-Jul-87	153	3200
30-Jul-87	160	3230
13-Aug-87	174	3490
20-Aug-87	181	3630
27-Aug-87	188	3700
31-Aug-87	192	3700
11-Sep-87	203	3820
16-Sep-87	208	3890
29-Sep-87	221	4470
07-Oct-87	229	4490
16-Oct-87	238	4510
22-Oct-87	244	4530
26-Oct-87	248	4590
30-Oct-87	252	4610
02-Nov-87	255	4700
05-Nov-87	258	4890
10-Nov-87	263	5190
13-Nov-87	266	5250
16-Nov-87	269	5270
25-Nov-87	278	5290
02-Dec-87	285	5250
15-Dec-87	298	5250
18-Dec-87	301	5250

TABLE 4.17 (CONTINUED)

K-2 STATION, PANEL 13H, ROOM 13H040
SMALL (NORTH) PILLAR TANGENTIAL PRESSURE

DATE	DAYS	PRESSURE 15' (PSI)
05-Jan-88	319	5300
07-Jan-88	321	5350
19-Jan-88	333	5375
29-Jan-88	343	5350
05-Feb-88	350	5300
08-Feb-88	353	5200

K-2 STATION, PANEL 13H, ROOM 13H040

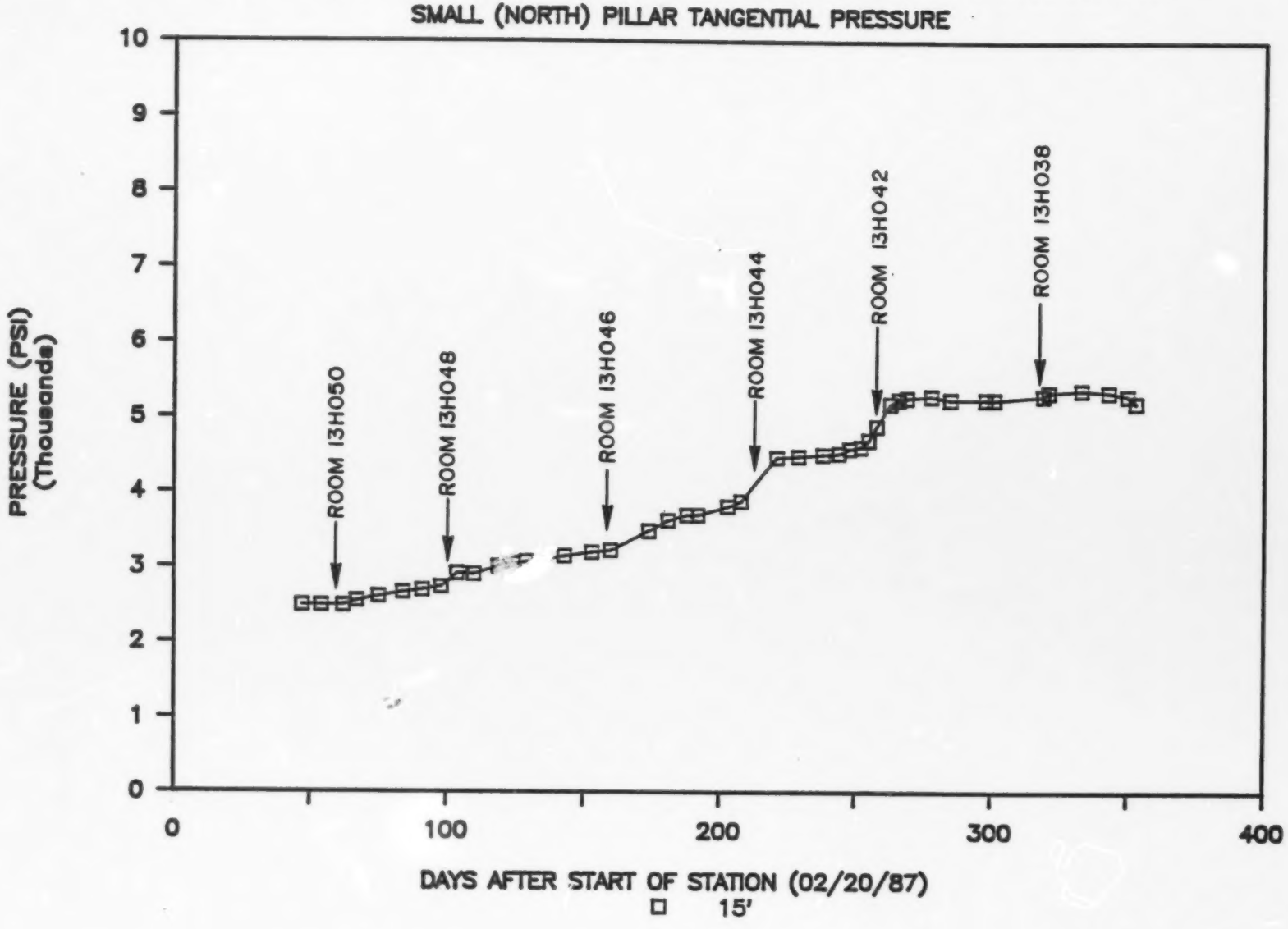


FIGURE 4.15

TABLE 4.18

K-2 STATION, PANEL 13H, ROOM 13H040
SMALL (NORTH) PILLAR ROD AND PLATE EXTENSOMETER

		15 FT. ANCHOR		10 FT. ANCHOR		5 FT. ANCHOR	
DATE	DAYS	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS.)	CUM. MOVEMENT (INS)
20-Feb-87	0	0	0	0	0	0	0
12-Mar-87	20	0.796	0.000	1.452	0.000	1.610	0.000
27-Mar-87	35	0.865	0.069	1.511	0.059	1.647	0.037
01-Apr-87	40	0.893	0.097	1.527	0.075	1.657	0.047
08-Apr-87	47	0.909	0.113	1.550	0.098	1.671	0.061
15-Apr-87	54	0.935	0.139	1.574	0.122	1.685	0.075
23-Apr-87	62	0.977	0.181	1.612	0.160	1.709	0.099
28-Apr-87	67	1.013	0.217	1.644	0.192	1.729	0.119
06-May-87	75	1.067	0.271	1.694	0.242	1.761	0.151
15-May-87	84	1.120	0.324	1.739	0.287	1.790	0.180
22-May-87	91	1.156	0.360	1.774	0.322	1.810	0.200
04-Jun-87	104	1.251	0.455	1.861	0.409	1.870	0.260
10-Jun-87	110	1.322	0.526	1.926	0.474	1.913	0.303
16-Jun-87	116	1.388	0.592	1.987	0.535	1.950	0.340
24-Jun-87	124	1.456	0.660			1.990	0.380
13-Jul-87	143	1.590	0.794	2.106	0.654	2.065	0.455
23-Jul-87	153	1.647	0.851	2.159	0.707	2.103	0.493
20-Aug-87	181	2.036	1.240			2.350	0.740
27-Aug-87	188	2.147	1.351	2.260	0.808	2.415	0.805
31-Aug-87	192	2.182	1.386	2.291	0.839	2.436	0.826
11-Sep-87	203	2.295	1.499	2.391	0.939	2.500	0.890
16-Sep-87	208	2.352	1.556	2.443	0.991	2.534	0.924
29-Sep-87	221					2.873	1.263
07-Oct-87	229					3.000	1.390
16-Oct-87	238					3.070	1.460
22-Oct-87	244					3.110	1.500
26-Oct-87	248					3.150	1.540
30-Oct-87	252	2.475	1.679	2.781	1.329	3.300	1.690
02-Nov-87	255	2.581	1.785	2.874	1.422	3.360	1.750
05-Nov-87	258	3.134	2.338	3.355	1.903	3.690	2.080
10-Nov-87	263					4.610	3.000
13-Nov-87	266	3.477	2.681	3.650	2.198	4.820	3.210
16-Nov-87	269	3.721	2.925	3.862	2.410	4.850	3.240
25-Nov-87	278	3.311	2.515	4.239	2.787	5.190	3.580
02-Dec-87	285	4.363	3.567	4.890	3.438	5.320	3.710
18-Dec-87	301	4.717	3.921	4.797	3.345	5.630	4.020
05-Jan-88	319	5.134	4.338	5.238	3.786	5.950	4.340
07-Jan-88	321	5.417	4.621	5.526	4.074	6.130	4.520
19-Jan-88	333	5.845	5.049	5.989	4.537	6.540	4.930
29-Jan-88	343	6.204	5.408	6.160	4.708	6.470	4.860
05-Feb-88	350	6.086	5.290	6.250	4.798	6.760	5.150
08-Feb-88	353	6.139	5.343	6.305	4.853	6.810	5.200

NOTES: (1) START OF STATION (20-FEB-87) IS USED AS COMMON REFERENCE POINT FOR PANEL 13H INSTRUMENTATION.
(2) *CUM. MOVEMENT REFERS TO CUMULATIVE ANCHOR MOVEMENT RELATIVE TO COLLAR OF HOLE.

TABLE 4.19

K-2 STATION, PANEL 13H, ROOM 13H040
SMALL (NORTH) PILLAR ROD AND PLATE EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 04-JUN-87 TO 23-JUL-87

	DATE	DAYS	15 FT. ANCHOR	10 FT. ANCHOR	5 FT. ANCHOR
			CUMULATIVE MOVEMENT (INS.)	CUMULATIVE MOVEMENT (INS.)	CUMULATIVE MOVEMENT (INS.)
	04-Jun-87	104	1.251	1.861	1.870
	23-Jul-87	153	1.647	2.159	2.103
DIFFERENCE		49	0.396	0.298	0.233
15 FT. - 10 FT. ANCHOR READING			0.098		
AV. STRAIN RATE (SEC-1)			3.86E-10		
10 FT. - 5 FT. ANCHOR READING				0.065	
AV. STRAIN RATE (SEC-1)				2.56E-10	
5 FT. - 0 FT. ANCHOR READING					0.2330
AV. STRAIN RATE (SEC-1)					9.17E-10

TABLE 4.20

K-2 STATION, PANEL 13H, ROOM 13H040
SMALL (NORTH) PILLAR ROD AND PLATE EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 30-OCT-87 TO 18-DEC-87

	DATE	DAYS	15 FT. ANCHOR	10 FT. ANCHOR	5 FT. ANCHOR
			CUMULATIVE MOVEMENT (INS.)	CUMULATIVE MOVEMENT (INS.)	CUMULATIVE MOVEMENT (INS.)
	30-Oct-87	252	2.475	2.781	3.300
	18-Dec-87	301	4.717	4.797	5.630
DIFFERENCE		49	2.242	2.015	2.330
15 FT. - 10 FT. ANCHOR READING			0.226		
AV. STRAIN RATE (SEC-1)			8.90E-10		
10 FT. - 5 FT. ANCHOR READING				-0.314	
AV. STRAIN RATE (SEC-1)				-1.24E-09	
5 FT. - 0 FT. ANCHOR READING					2.3300
AV. STRAIN RATE (SEC-1)					9.17E-09

K–2 STATION, PANEL 13H, ROOM 13H040

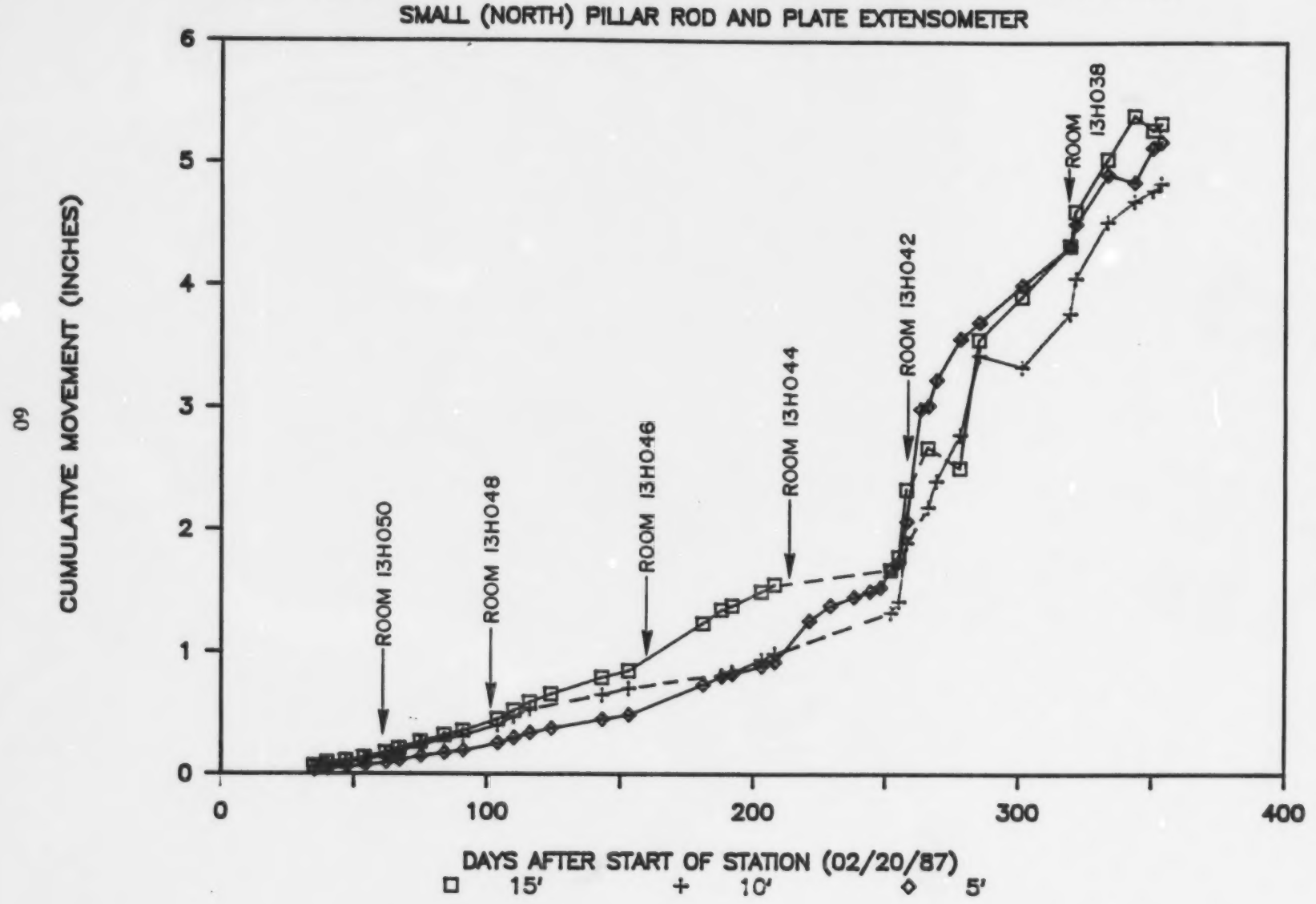


FIGURE 4.16

4.7 Photographs of Installation

The following photographs show the instrumentation installation of the Rock Mechanics Strata in Room 10H040, Panel 13H, K-2 Mine.

PHOTO 4.1: K-2 Station showing 6-point back extensometer, roof cells and floor rod and plate extensomete. installations. Photo taken looking southeast.

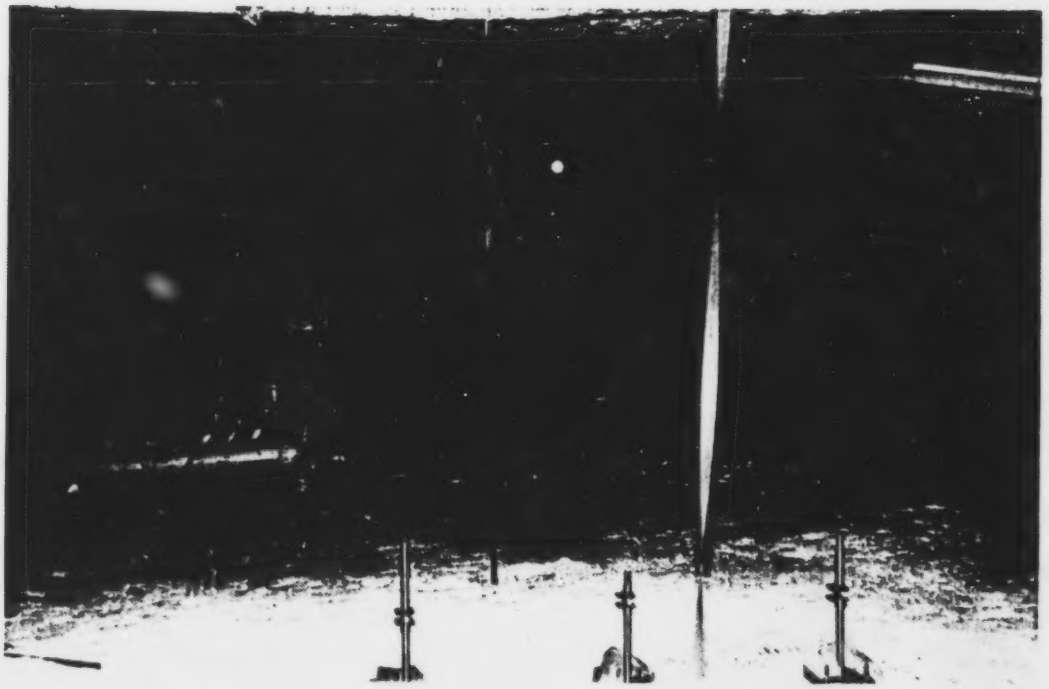


PHOTO 4.2: K-2 Station showing floor rod and plate extensometers in foreground and wall cells in background. Photo taken looking south.

PHOTO 4.3: K-2 Station showing 6-point wall extensometer on left hand side and wall cells in foreground. Photo taken looking southeast.

PHOTO 4.4: K-2 Station showing horizontal closure reference point and wall cells on either side. Photo taken looking south.

PHOTO 4.5: K-2 Station showing 6-point wall extensometer installed in (south) large pillar with anchor point references. Photo taken looking south.

PHOTO 4.6: K-2 Station showing south wall cells in foreground and edge of cut-out for radial cells in background. Photo taken looking west.

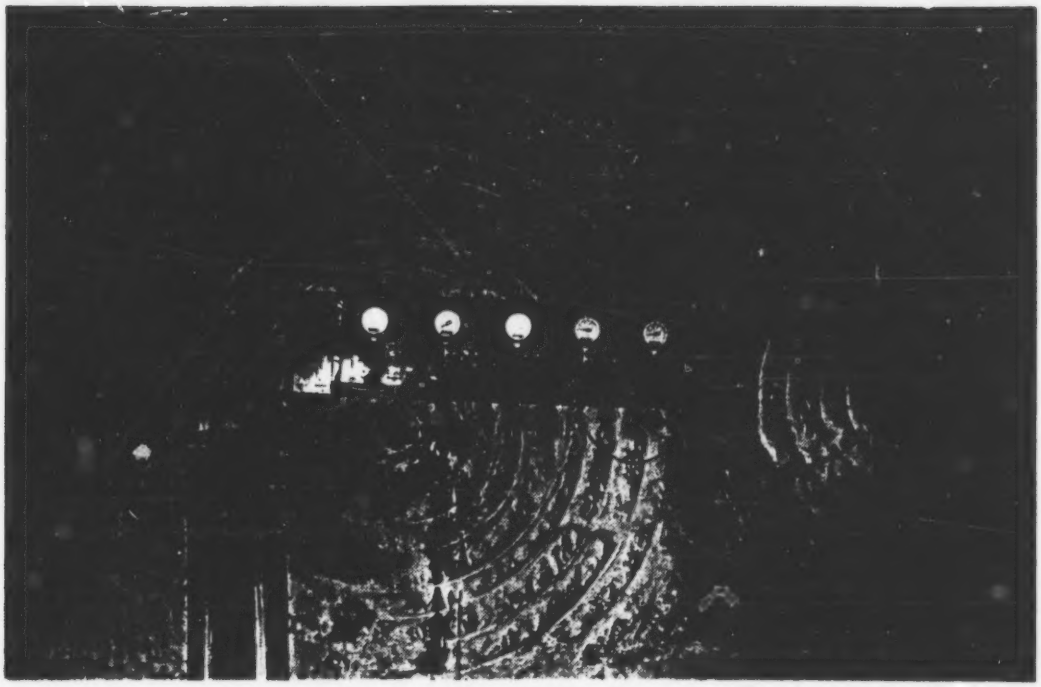


PHOTO 4.7: K-2 Station showing radial cell installation in south rib cut-out. Radial cells are installed at, from left to right, 5, 10, 15, 20, and 25-foot depths into the (south) large pillar. Photo taken looking east.

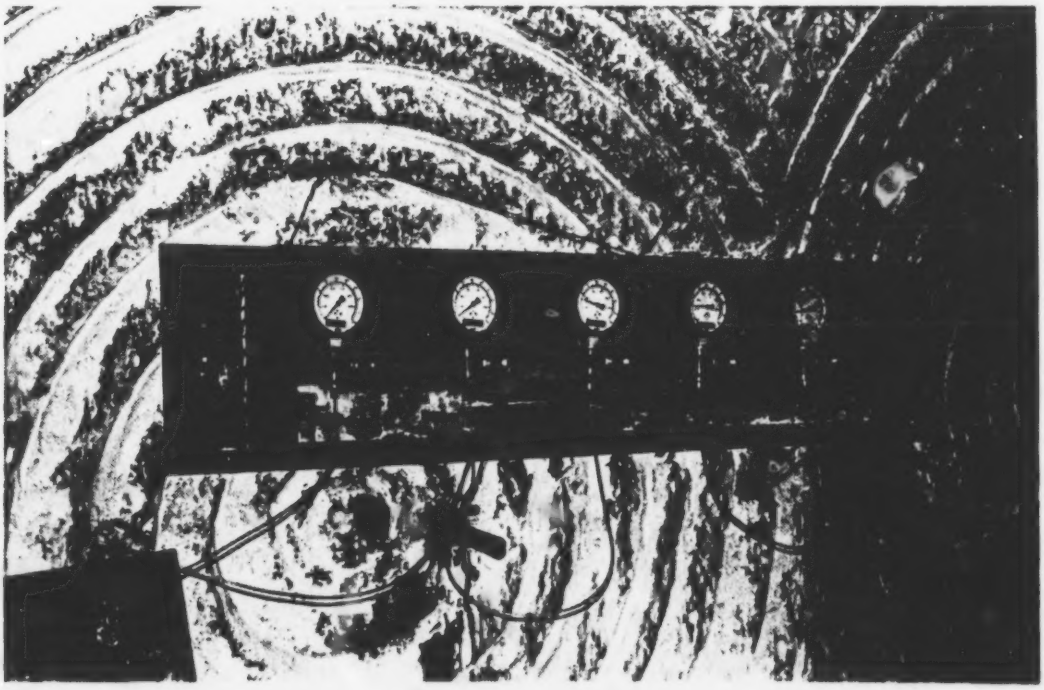


PHOTO 4.8: K-2 Station showing close-up of radial cell gauges in south rib cut-out. Photo taken looking east.

PHOTO 4.9: K-2 Station showing close up of 15-foot wall cell installation in (north) small pillar, 30-foot width. Gauge is seen with stainless steel line leading to grouting cell in lower center of photo. Photo taken looking north.

SECTION 5.0

5.0 IN SITU TESTING IN PANEL 12E

The test site in Panel 12E was selected so as to locate the rock mechanics station initially in 'virgin' ground.

Room 12E024 was excavated after retreat mining from the boundary was initiated.

Installation and commissioning of instrumentation was completed while mining activities were about 800 feet away to the west. The response of the test site instrumentation to the advancing mining machine was then monitored.

This site experienced numerous pressure cell failures at approximately Day 140 from the start of the station. This occurred when the Marietta miner was in Room 12E026 and in very close proximity to the station.

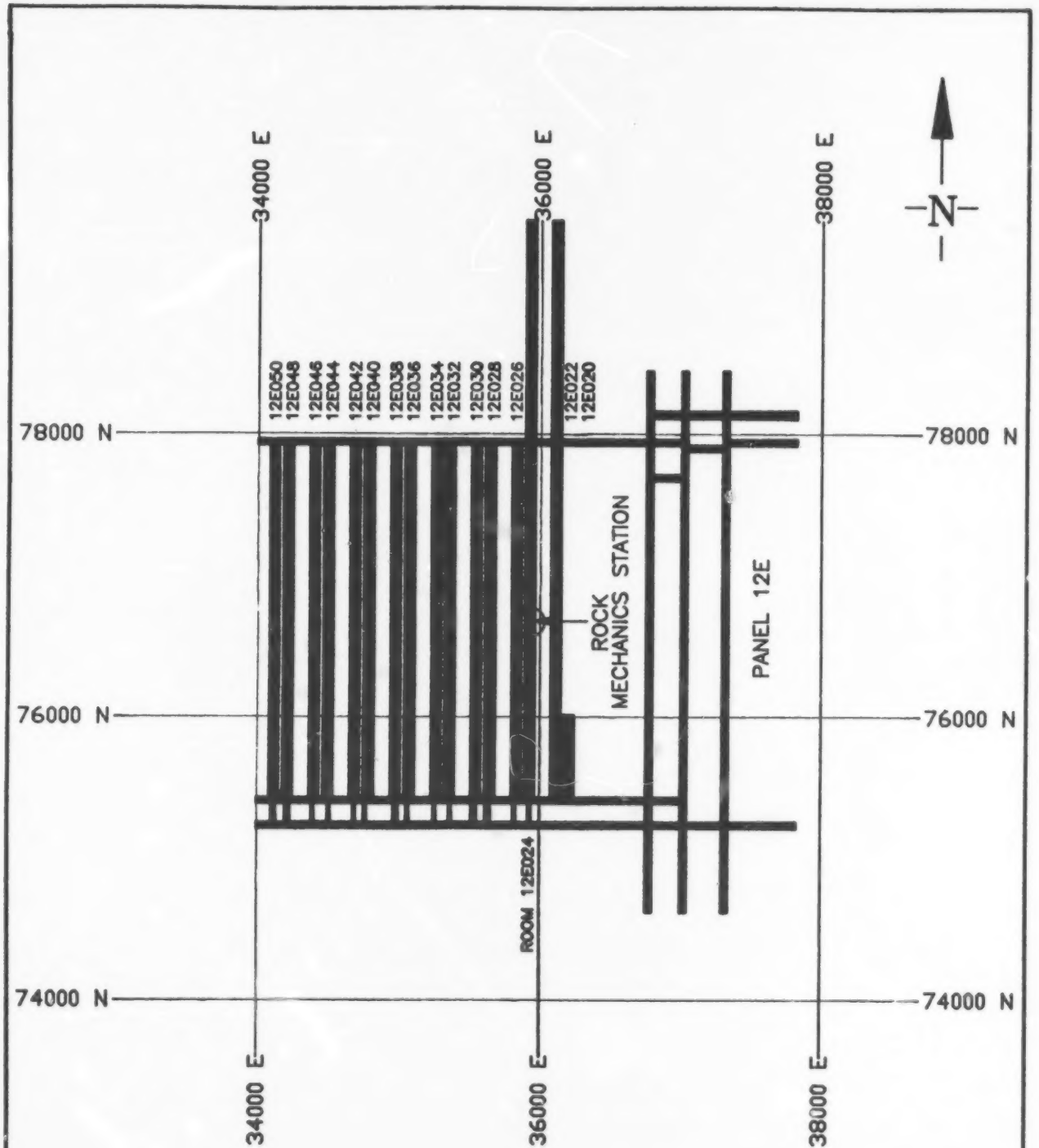
So little instrumentation remained operational by the end of December 1987 that it was decided to abandon the station in January 1988 and to salvage as much of the remote data acquisition equipment as possible. This was done and the station is no longer active.

5.1 Location, Timing, Mining Sequence and Instrumentation Description

The location of this Rock Mechanics Station is shown in Figure 5.1. Note mining machine position as of February 5, 1988, relative to the Rock Mechanics Station.

The progress of the mining machine (020 miner) in each room of Panel 12E is summarized in Table 5.1 and Figure 5.2. Instrumentation drilling was completed on June 19, 1987. Cell installation and grouting was completed on June 19, 1987.

The instrumentation layout is shown schematically in Figure 5.3.



NOTE :
FULL MINE PLAN DETAILS NOT SHOWN
SCALE 1" = 1000'

MPC Mraz Project Consultants Ltd. 418 JESSOP AVE. SASKATOON, SASKATCHEWAN, CANADA S7N 2S5 Ph. (306) 955-6248 TELEX 674 - 2636 MINZ SKN TELEFAX 955-6244	FIGURE 5.1 INTERNATIONAL MINERALS AND CHEMICAL CORP. (CANADA) LTD. K-1 MINE, PANEL 12E LOCATION OF ROCK MECHANICS STATION IN PANEL 12E
DWN.# MPC-0039-A | DATE: OCT. 25, 1988	
DWN. BY: DWAYNE B.GUDMUNDSSON	

TABLE 5.1

K-1 MINE, PANEL 12E
MINER LOCATION

DATE	DAYS	ROOM	FOOTAGE FROM START OF MINING ROOM				
25-Jun-87	0	12E032	2040				
08-Jul-87	13		2560				
14-Jul-87	19		2810				
28-Jul-87	33		3160				
06-Aug-87	42		3310				
10-Aug-87	46	12E030		0			
17-Aug-87	53			560			
25-Aug-87	61			1330			
01-Sep-87	68			2010			
15-Sep-87	82			2700			
17-Sep-87	84	12E028			0		
23-Sep-87	90				110		
29-Sep-87	96				520		
08-Oct-87	105				1170		
22-Oct-87	119				1910		
27-Oct-87	124				2650		
02-Nov-87	130	12E026				250	
06-Nov-87	134					710	
09-Nov-87	137					940	
13-Nov-87	141					1520	
17-Nov-87	145					2000	
20-Nov-87	148					2260	
23-Nov-87	151					2950	
30-Nov-87	158					3000	
03-Dec-87	161						100
11-Dec-87	169	12E022					400
16-Dec-87	174						1000
04-Jan-88	193						2130
15-Jan-88	204						2300
18-Jan-88	207						2600
21-Jan-88	210						2820
25-Jan-88	214						3175
29-Jan-88	218						0
01-Feb-88	221	12E020					300
05-Feb-88	225						580

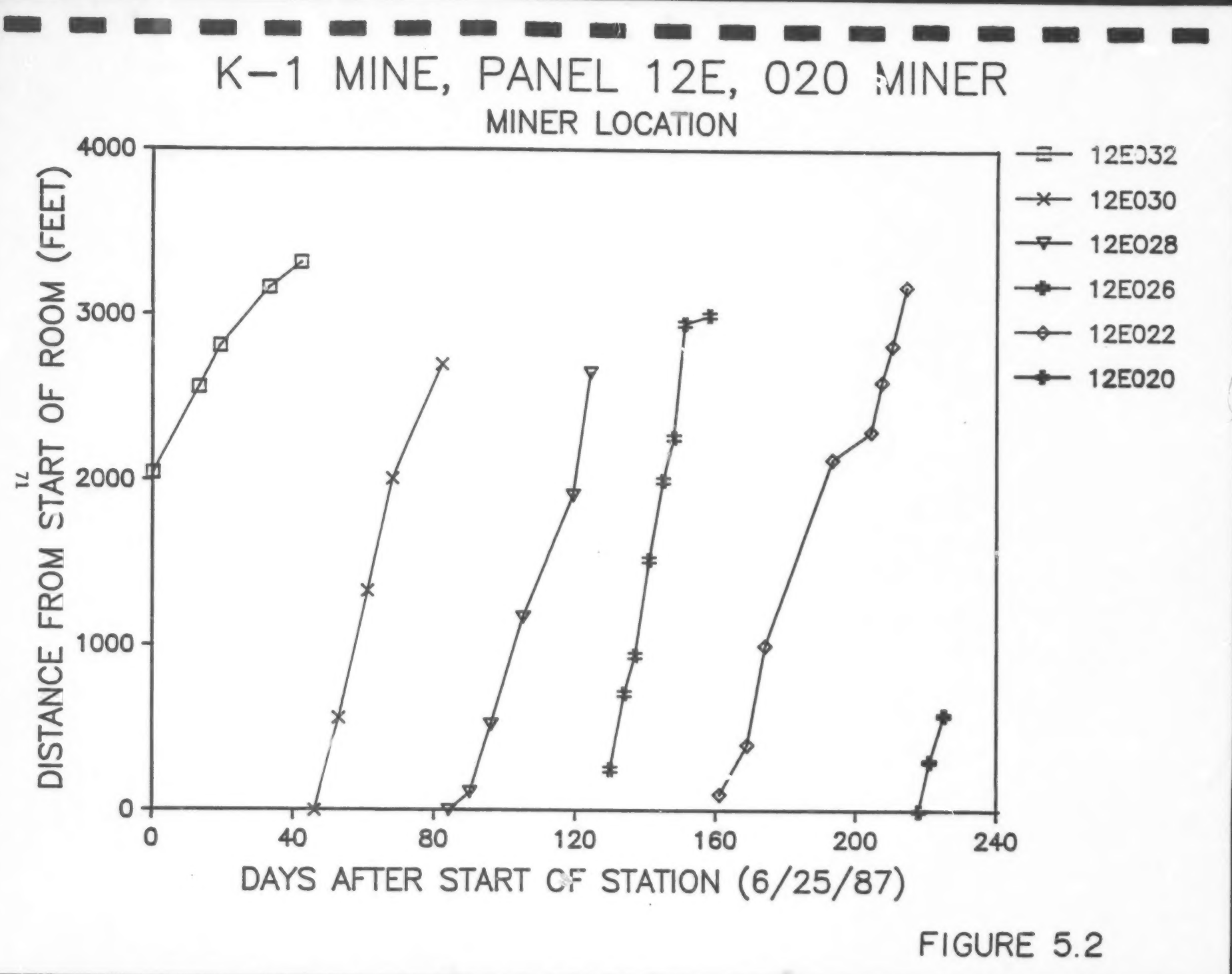

K-1 MINE, PANEL 12E, 020 MINER
MINER LOCATION
DISTANCE FROM START OF ROOM (FEET)
4000
3000
2000
1000
0
0
40
80
120
160
200
240
DAYS AFTER START OF STATION (6/25/87)
12E032
12E030
12E028
12E026
12E022
12E020

FIGURE 5.2

The installations are similar to that used at the Panel 13H site as described in Section 4.1, with the exception that they were remotely monitored by the means of pressure transducers and a data logging system supplied and installed by the Saskatchewan Research Council.

Remote monitoring was selected in anticipation that the roof at the rock mechanics station site would deteriorate rapidly after mining the adjacent rooms in this high carnallite area and, hence, be safe for personnel to enter without requiring major roof support work. This proved to be the case.

Vertical Closure Station

A single vertical closure meter was installed as shown in Figure 5.3 in the center of Room 12E024, connecting the roof and floor. Data from this meter was recorded by the data acquisition system sensor and channel references follow:

CHANNEL NO.	SENSOR TYPE	POWER SUPPLY	VOLTAGE DIVIDER CIRCUIT #	EXCITATION (Volts)
25	Vertical Closure Meter	1	7	0.9837

Horizontal Closure Station

A single horizontal closure meter was installed as shown in Figure 5.3 between the east and west pillar walls. Data from this meter was recorded by the data acquisition system. The SRC-REMDAC system sensor and channel references follow:

CHANNEL NO.	SENSOR TYPE	POWER SUPPLY	VOLTAGE DIVIDER CIRCUIT #	EXCITATION (Volts)
24	Horizontal Closure Meter	2	8	1.0052

Borehole 6-Point Extensometer

This instrument was installed as shown in Figure 5.3 to measure relative movement or strain in the large (east) pillar. Readings were recording by the data acquisition system. The SRC-REMDAC system sensor and channel references follow:

ANCHOR DEPTH (ft)	CHANNEL NO.	SENSOR TYPE	POWER SUPPLY	VOLTAGE DIVIDER CIRCUIT #	EXCITATION (Volts)
5	30	6-point extensometer	1	5	0.9947
10	29		2	4	0.9942
15	28		1	3	0.9917
20	27		2	2	0.9997
25	26		1	1	0.9862
50	31		2	6	0.9952

Borehole Rod and Plate Extensometers

None of these instruments were installed.

Radial Pressure Cells

SRC cells were installed in the large (east) pillar as shown in Figure 5.3 to measure radial pressure. Readings were recorded by the data acquisition system. The SRC-REMDAC system sensor and channel references follow:

CELL DEPTH (ft)	CELL ORIENTATION	CHANNEL NO.	SENSOR TYPE	SERIAL NO.	POWER SUPPLY	EXCITATION (Volts)
10	RADIAL	7	Transducer	26860	"	10
15	"	6	"	26855	"	10
20	"	5	"	26861	"	10

Tangential Pressure Cells

SRC cells were installed in the small (west) pillar and large (east) pillar as shown in Figure 5.3 to measure tangential pressure. Readings were recorded by the data acquisition system.

The SRC-REMDAC system sensor and channel references for the small (west) pillar follow:

CELL DEPTH (ft)	CELL ORIENTATION	CHANNEL NO.	SENSOR TYPE	SERIAL NO.	POWER SUPPLY	EXCITATION (Volts)
5	Horizontal	17	"	26851	"	10
10	"	15	"	26854	"	10
15	"	13	"	26864	"	10

The SRC-REMDAC system sensor and channel references for the large (east) pillar follow:

CELL DEPTH (ft)	CELL ORIENTATION	CHANNEL NO.	SENSOR TYPE	SERIAL NO.	POWER SUPPLY	EXCITATION (Volts)
5	Horizontal	9	"	26868	5 & 6	10
10	"	11	"	26859	"	10
15	"	0	"	26857	3 & 4	10
20	"	2	"			10
50	"	4	"	26852	"	10

Lateral Pressure Cells

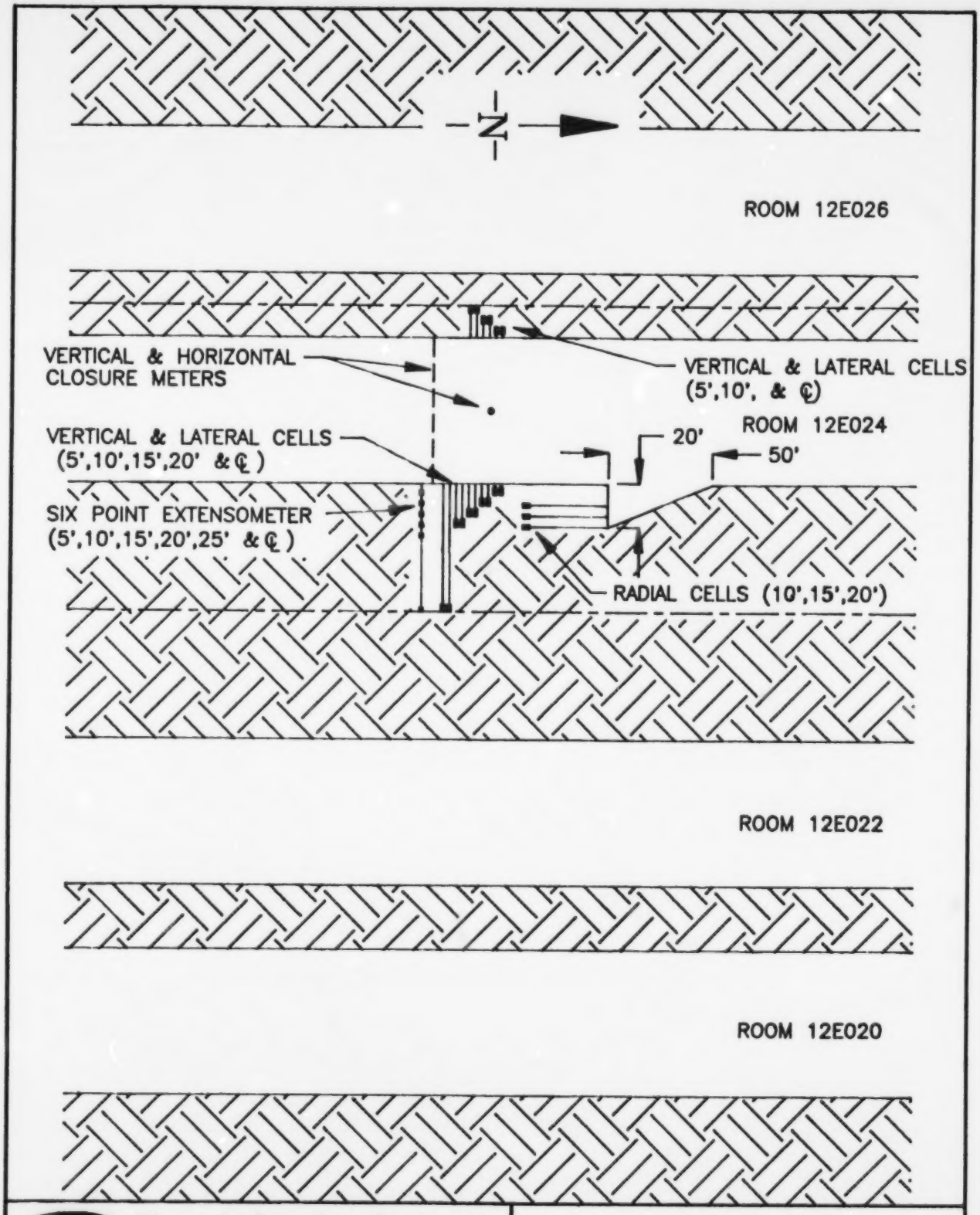
SRC cells were installed in the small (west) pillar and large (east) pillar as shown on Figure 5.3 to measure lateral pressure. Readings were recorded by the data acquisition system.

The SRC-REMDAC system sensor and channel references for the small (west) pillar follow:

CELL DEPTH (ft)	CELL ORIENTATION	CHANNEL NO.	SENSOR TYPE	SERIAL NO.	POWER SUPPLY	EXCITATION (Volts)
10	VERTICAL	16	PRESSURE	26856	5 & 6	10
15	"	14	TRANSDUCER	26869	"	10

The SRC-REMDAC system sensor and channel references for the large (east) pillar follow:

CELL DEPTH (ft)	CELL ORIENTATION	CHANNEL NO.	SENSOR TYPE	SERIAL NO.	POWER SUPPLY	EXCITATION (Volts)
5	Vertical	8	Pressure	26862	5 & 6	10
10	"	10	Transducer	26867	"	10
15	"	12	"	26865	"	10
20	"	1	"	26866	3 & 4	10
50	"	3	"	26858	"	10



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DWN.# MPC-0039-C | DATE: OCT. 25, 1988

DWN. BY: DWAYNE B.GUDMUNDSSON

FIGURE 5.3

INTERNATIONAL MINERALS AND CHEMICAL CORP. (CANADA) LTD.
K-1 MINE, PANEL 12E

REMOTELY MONITORED ROCK MECHANICS STATION - ROOM 12E024

5.2 Closure Instrumentation

The following tables and figures record data for the closure instrumentation in Room 12E024.

TABLE 5.2

K-1 STATION, PANEL 12E, ROOM 12E024
VERTICAL CLOSURE STATION

DATE	DAYS	CHANNEL 25 CUMULATIVE CLOSURE (CM.)	(INS.)
25-Jun-87	0	0.340	0.134
26-Jun-87	1	0.340	0.134
02-Jul-87	7	0.340	0.134
08-Jul-87	13	0.340	0.134
14-Jul-87	19	0.340	0.134
23-Jul-87	28	1.562	0.615
28-Jul-87	33	1.791	0.705
04-Aug-87	40	2.021	0.795
06-Aug-87	42	2.173	0.856
11-Aug-87	47	2.326	0.916
17-Aug-87	53	2.555	1.006
25-Aug-87	61	2.861	1.126
01-Sep-87	68	3.167	1.247
08-Sep-87	75	3.778	1.487
15-Sep-87	82	4.236	1.668
23-Sep-87	90	4.771	1.878
29-Sep-87	96	5.077	1.999
08-Oct-87	105	5.611	2.209
20-Oct-87	117	7.094	2.793
27-Oct-87	124	7.827	3.082
02-Nov-87	130	8.286	3.262
06-Nov-87	134	8.591	3.382
09-Nov-87	137	8.820	3.473
13-Nov-87	141	11.235	4.423
16-Nov-87	144	13.405	5.277
17-Nov-87	145	13.787	5.428
20-Nov-87	148	14.551	5.729
23-Nov-87	151	15.086	5.939
30-Nov-87	158	16.079	6.330
03-Dec-87	161	16.461	6.481
11-Dec-87	169	17.225	6.781
16-Dec-87	174	17.683	6.962
04-Jan-88	193	19.211	7.564
15-Jan-88	204	22.038	8.676
18-Jan-88	207	22.497	8.857
21-Jan-88	210	22.879	9.007
25-Jan-88	214	23.414	9.218
29-Jan-88	218	23.811	9.374
01-Feb-88	221	24.178	9.519
05-Feb-88	225	24.360	9.669
09-Feb-88	229	24.842	9.780

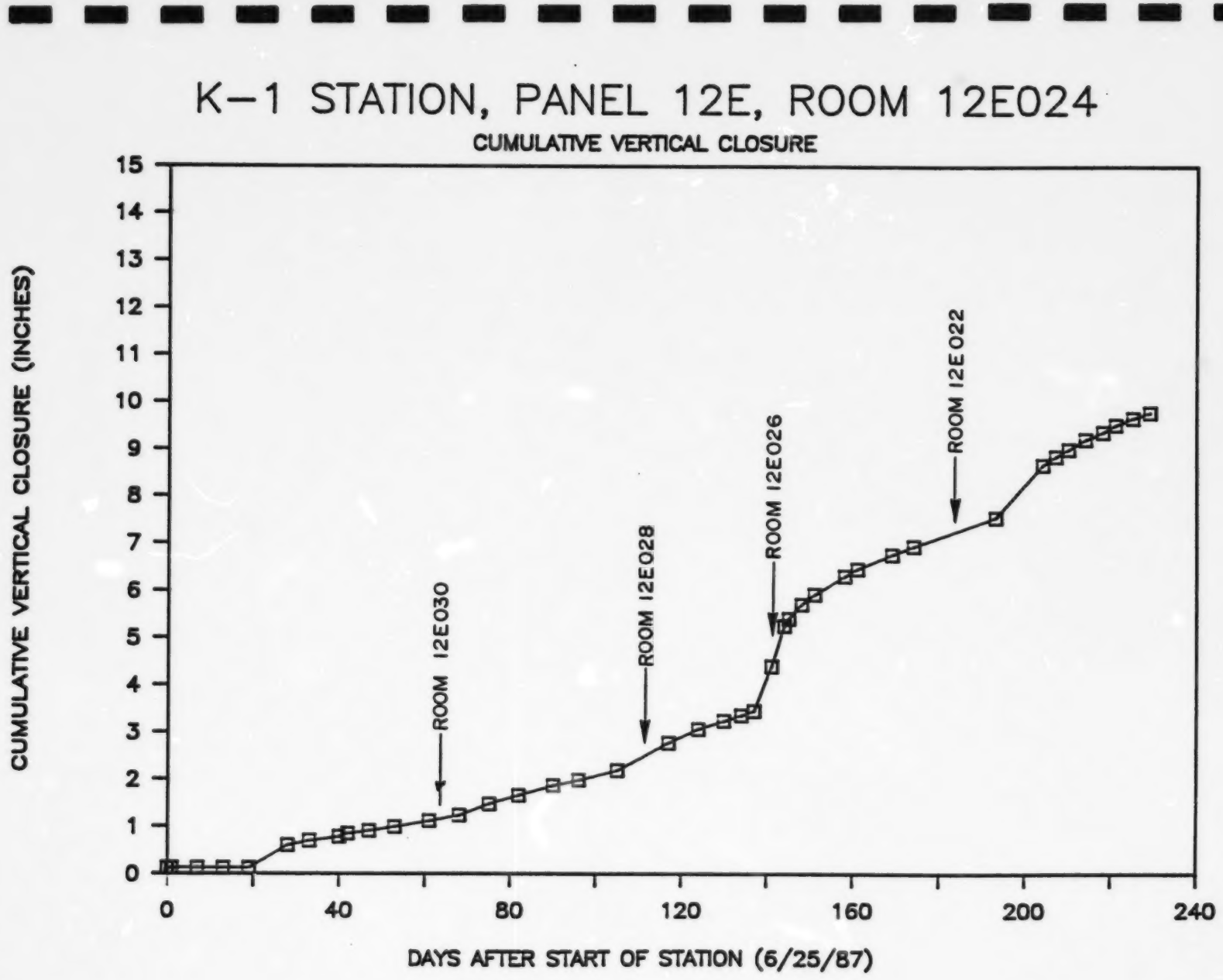

K-1 STATION, PANEL 12E, ROOM 12E024
CUMULATIVE VERTICAL CLOSURE
CUMULATIVE VERTICAL CLOSURE (INCHES)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
0
40
80
120
160
200
240
DAYS AFTER START OF STATION (6/25/87)
ROOM 12E030
ROOM 12E028
ROOM 12E026
ROOM 12E022

FIGURE 5.4

TABLE 5.3

K-1 STATION, PANEL 12E, ROOM 12E024
HORIZONTAL CLOSURE STATION

DATE	DAYS	CHANNEL 24 CUMULATIVE CLOSURE (CM.)	(INS.)
25-Jun-87	0	0.000	0.000
26-Jun-87	1	0.150	0.059
02-Jul-87	7	1.573	0.619
08-Jul-87	13	2.097	0.826
14-Jul-87	19	2.622	1.032
23-Jul-87	28	3.371	1.327
28-Jul-87	33	3.595	1.416
04-Aug-87	40	4.045	1.592
06-Aug-87	42	4.120	1.622
11-Aug-87	47	4.419	1.740
17-Aug-87	53	4.794	1.887
25-Aug-87	61	5.543	2.182
01-Sep-87	68	5.843	2.300
08-Sep-87	75	6.666	2.625
15-Sep-87	82	7.416	2.919
23-Sep-87	90	8.314	3.273
29-Sep-87	96	8.839	3.480
08-Oct-87	105	9.588	3.775
20-Oct-87	117	11.685	4.600
27-Oct-87	124	12.884	5.072
02-Nov-87	130	13.633	5.367
06-Nov-87	134	14.157	5.574
09-Nov-87	137	14.606	5.751
17-Nov-87	145	14.606	5.751
20-Nov-87	148	16.179	6.370
23-Nov-87	151	17.677	6.960
30-Nov-87	158	20.224	7.962
03-Dec-87	161	20.898	8.228
11-Dec-87	169	22.696	8.935
16-Dec-87	174	23.670	9.319
04-Jan-88	193	27.385	10.781
15-Jan-88	204	34.067	13.412
18-Jan-88	207	35.355	13.919
21-Jan-88	210	36.389	14.326
25-Jan-88	214	37.707	14.845
29-Jan-88	218	38.651	15.217

K-1 STATION, PANEL 12E, ROOM 12E024

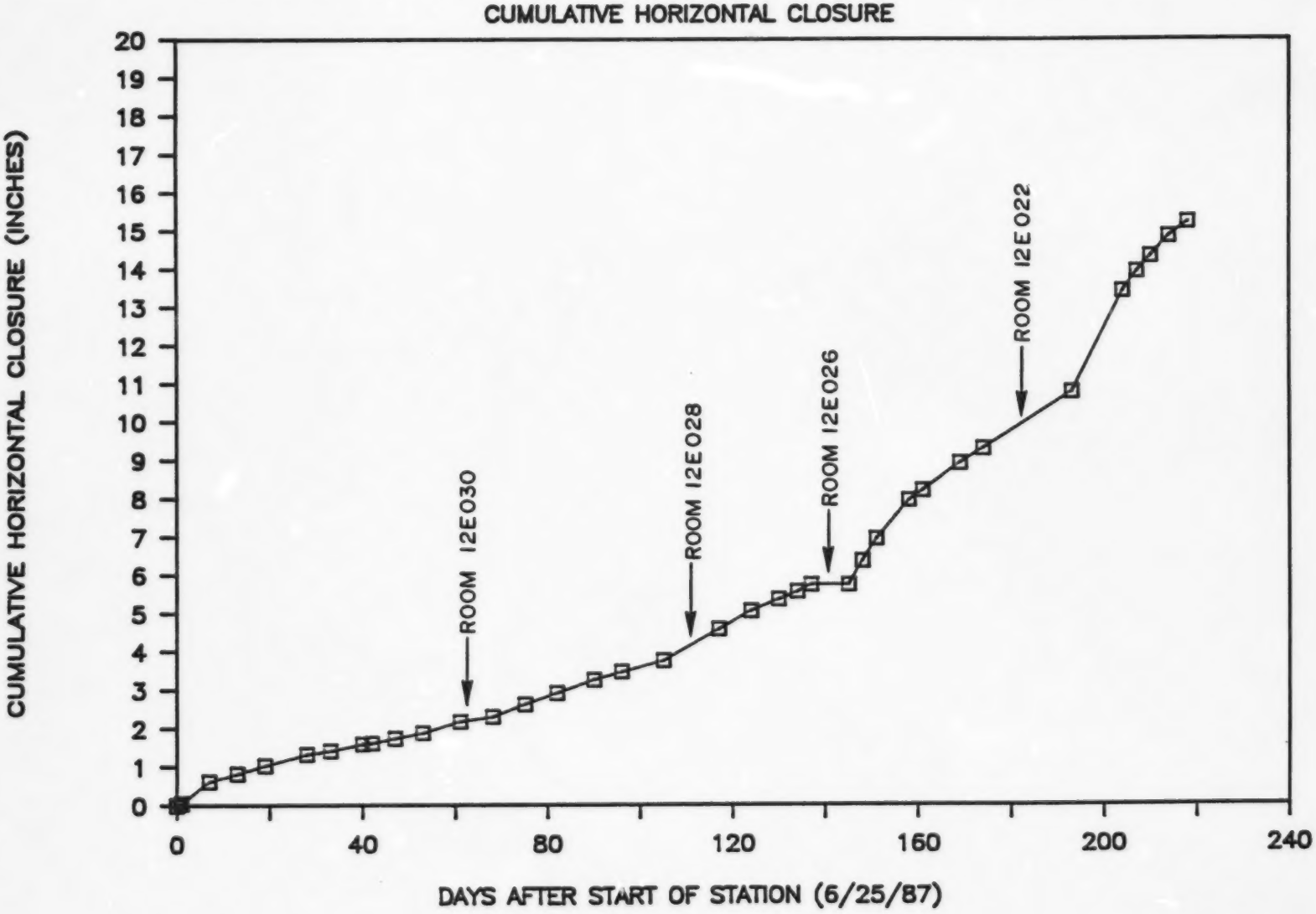


FIGURE 5.5

5.3 Large (East) Pillar Instrumentation

The following tables and figures record data for the large (east) pillar instrumentation in Room 12E024.

TABLE 5.4

K-1 STATION, PANEL 12E, ROOM 12E024
LARGE (EAST) PILLAR 6-CHANNEL EXTENSOMETER

DATE	DAYS	CHANNEL 31 50 FT. ANCHOR		CHANNEL 26 25 FT. ANCHOR		CHANNEL 27 20 FT. ANCHOR		CHANNEL 28 15 FT. ANCHOR		CHANNEL 29 10 FT. ANCHOR		CHANNEL 30 5 FT. ANCHOR	
		READING (INS.)	CUM. MOVEMENT (INS.)	READING (INS)	CUM. MOVEMENT (INS.)	READING (INS)	CUM. MOVEMENT (INS.)	READING (INS)	CUM. MOVEMENT (INS.)	READING (INS)	CUM. MOVEMENT (INS.)	READING (INS)	CUM. MOVEMENT (INS.)
25-Jun-87	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17-Aug-87	53	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25-Aug-87	61	-0.0119	-0.0119	0.0480	0.0480	0.0296	0.0296	0.0418	0.0418	0.0595	0.0595	0.0596	0.0596
01-Sep-87	68	-0.0119	-0.0119	0.1081	0.1081	0.0889	0.0889	0.1015	0.1015	0.1191	0.1191	0.0894	0.0894
08-Sep-87	75	-0.0119	-0.0119	0.1982	0.1982	0.1482	0.1482	0.1911	0.1911	0.2084	0.2084	0.1789	0.1789
15-Sep-87	82	-0.0119	-0.0119	0.2883	0.2883	0.2371	0.2371	0.3105	0.3105	0.2679	0.2679	0.2981	0.2981
23-Sep-87	90	-0.0119	-0.0119	0.4084	0.4084	0.3556	0.3556	0.4011	0.4011	0.3870	0.3870	0.4174	0.4174
29-Sep-87	96	0.0000	0.0000	0.4684	0.4684	0.4445	0.4445	0.4597	0.4597	0.4406	0.4406	0.4770	0.4770
08-Oct-87	105	-0.0119	-0.0119	0.5885	0.5885	0.5335	0.5335	0.5791	0.5791	0.5359	0.5359	0.5664	0.5664
20-Oct-87	117	-0.0060	-0.0060	0.8888	0.8888	0.8002	0.8002	0.8179	0.8179	0.7741	0.7741	0.8646	0.8646
27-Oct-87	124	-0.0060	-0.0060	1.0390	1.0390	0.9484	0.9484	0.9672	0.9672	0.8932	0.8932	1.0136	1.0136
02-Nov-87	130	-0.0004	-0.0004	1.1591	1.1591	1.0669	1.0669	1.0567	1.0567	1.0122	1.0122	1.1329	1.1329
06-Nov-87	134	-0.0118	-0.0118	1.2191	1.2191	1.1262	1.1262	1.1164	1.1164	1.0718	1.0718	1.2223	1.2223
09-Nov-87	137	-0.0118	-0.0118	1.2491	1.2491	1.1855	1.1855	1.1761	1.1761	1.1015	1.1015	1.2521	1.2521
13-Nov-87	141	-0.0119	-0.0119	1.5494	1.5494	1.4818	1.4818	1.4448	1.4448	1.3695	1.3695	1.5502	1.5502
16-Nov-87	144	-0.0122	-0.0122	2.0299	2.0299	1.9264	1.9264	1.8928	1.8928	1.7863	1.7863	2.0282	2.0282
17-Nov-87	145	-0.0119	-0.0119	2.1200	2.1200	2.0449	2.0449	1.9821	1.9821	1.8756	1.8756	2.1465	2.1465
20-Nov-87	148	-0.0134	-0.0134	2.3602	2.3602	2.2820	2.2820	2.1908	2.1908	2.0840	2.0840	2.3850	2.3850
23-Nov-87	151	-0.0134	-0.0134	2.5403	2.5403	2.4302	2.4302	2.3702	2.3702	2.2328	2.2328	2.5340	2.5340
30-Nov-87	158	-0.0134	-0.0134	2.8706	2.8706	2.7265	2.7265	2.6388	2.6388	2.5008	2.5008	2.8918	2.8918
03-Dec-87	161	-0.0134	-0.0134	2.9607	2.9607	2.8451	2.8451	2.7582	2.7582	2.5901	2.5901	3.0110	3.0110
11-Dec-87	169	-0.0134	-0.0134	3.2009	3.2009	3.0822	3.0822	3.0066	3.0066	2.7985	2.7985	3.2495	3.2495
16-Dec-87	174	0.0179	0.0179	3.3511	3.3511	3.2007	3.2007	3.0866	3.0866	2.9176	2.9176	3.3688	3.3688
04-Jan-88	193	0.1965	0.1965	3.8315	3.8315	3.6453	3.6453	3.5344	3.5344	3.3050	3.3050	3.9054	3.9054
15-Jan-88	204	0.8037	0.8037	5.1827	5.1827	4.9196	4.9196	4.7284	4.7284	4.3470	4.3470	5.4854	5.4854
18-Jan-88	207	0.9108	0.9108	5.3929	5.3929	5.1762	5.1762	4.9374	4.9374	4.5252	4.5252	5.6941	5.6941
21-Jan-88	210	0.9703	0.9703	5.5491	5.5491	5.2456	5.2456	5.0747	5.0747	4.6443	4.6443	5.8432	5.8432
25-Jan-88	214	1.0596	1.0596	5.7353	5.7353	5.4531	5.4531	5.2359	5.2359	4.7932	4.7932	6.0519	6.0519
29-Jan-88	218	1.1489	1.1489	5.9034	5.9034	5.6013	5.6013	5.4150	5.4150	4.9420	4.9420	6.2307	6.2307
01-Feb-88	221	1.1847	1.1847	5.9935	5.9935	5.6902	5.6902	5.5045	5.5045	5.0313	5.0313	6.3500	6.3500
05-Feb-88	225			6.1436	6.1436	5.8087	5.8087	5.6239	5.6239	5.1504	5.1504	6.4692	6.4692
09-Feb-88	229	1.3037	1.3037	6.2637	6.2637	5.9510	5.9510	5.7434	5.7434	5.2695	5.2695	6.5885	6.5885

NOTES: (1) START OF STATION (25-JUN-87) IS USED AS COMMON REFERENCE POINT FOR PANEL 12E INSTRUMENTATION.
(2) "CUM. MOVEMENT" REFERS TO CUMULATIVE ANCHOR MOVEMENT RELATIVE TO COLLAR OF HOLE.

TABLE 5.5

K-1 STATION, PANEL 12E, ROOM 12E024
LARGE (EAST) PILLAR 6-CHANNEL EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 17-AUG-87 TO 01-SEPT-87

DATE	DAYS	CHANNEL 31 50 FT. ANCHOR READING (INS.)	CHANNEL 26 25 FT. ANCHOR READING (INS.)	CHANNEL 27 20 FT. ANCHOR READING (INS.)	CHANNEL 28 15 FT. ANCHOR READING (INS.)	CHANNEL 29 10 FT. ANCHOR READING (INS.)	CHANNEL 30 5 FT. ANCHOR READING (INS.)
17-Aug-87	53	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
01-Sep-87	68	-0.0120	0.1083	0.0880	0.1016	0.1189	0.0894
DIFFERENCE	15	-0.012	0.108	0.088	0.102	0.119	0.089
50 FT. TO 25 FT. ANCHOR READING		-0.120					
AV. STRAIN RATE (SEC-1)		-3.09E-10					
25 FT. TO 20 FT. ANCHOR READING			0.020				
AV. STRAIN RATE (SEC-1)			2.57E-10				
20 FT. TO 15 FT. ANCHOR READING				-0.014			
AV. STRAIN RATE (SEC-1)				-1.80E-10			
15 FT. TO 10 FT. ANCHOR READING					-0.017		
AV. STRAIN RATE (SEC-1)					-2.19E-10		
10 FT. TO 5 FT. ANCHOR READING						0.03	
AV. STRAIN RATE (SEC-1)						3.86E-10	
5 FT. TO 0 FT. ANCHOR READING							0.089
AV. STRAIN RATE (SEC-1)							1.14E-09

TABLE 5.6

K-1 STATION, PANEL 12E, ROOM 12E024
LARGE (EAST) PILLAR 6-CHANNEL EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 23-SEPT-87 TO 08-OCT-87

DATE	DAYS	CHANNEL 31 50 FT. ANCHOR READING (INS.)	CHANNEL 26 25 FT. ANCHOR READING (INS.)	CHANNEL 27 20 FT. ANCHOR READING (INS.)	CHANNEL 28 15 FT. ANCHOR READING (INS.)	CHANNEL 29 10 FT. ANCHOR READING (INS.)	CHANNEL 30 5 FT. ANCHOR READING (INS.)
23-Sep-87	90	-0.0120	0.4083	0.3555	0.4012	0.3870	0.4173
08-Oct-87	105	-0.0120	0.5886	0.5335	0.5791	0.5358	0.5665
DIFFERENCE	15	0.000	0.180	0.178	0.178	0.148	0.149
50 FT. TO 25 FT. ANCHOR READING		-0.180					
AV. STRAIN RATE (SEC-1)		-4.64E-10					
25 FT. TO 20 FT. ANCHOR READING			0.020				
AV. STRAIN RATE (SEC-1)			2.57E-10				
20 FT. TO 15 FT. ANCHOR READING				0			
AV. STRAIN RATE (SEC-1)				0.00E+00			
15 FT. TO 10 FT. ANCHOR READING					0.03		
AV. STRAIN RATE (SEC-1)					3.86E-10		
10 FT. TO 5 FT. ANCHOR READING						-0.001	
AV. STRAIN RATE (SEC-1)						-1.29E-11	
5 FT. TO 0 FT. ANCHOR READING							0.149
AV. STRAIN RATE (SEC-1)							1.92E-09

TABLE 5.7

K-1 STATION, PANEL 12E, ROOM 12E024
LARGE (EAST) PILLAR 6-CHANNEL EXTENSOMETER

AVERAGE STRAIN RATE (SEC-1), PERIOD 21-JAN-88 TO 09-FEB-88

	DATE	DAYS	CHANNEL 31 50 FT. ANCHOR READING (INS.)	CHANNEL 26 25 FT. ANCHOR READING (INS.)	CHANNEL 27 20 FT. ANCHOR READING (INS.)	CHANNEL 28 15 FT. ANCHOR READING (INS.)	CHANNEL 29 10 FT. ANCHOR READING (INS.)	CHANNEL 30 5 FT. ANCHOR READING (INS.)
	21-Jan-88	210	0.9705	5.5492	5.2457	5.0748	4.6445	5.8433
	09-Feb-88	229	1.3035	6.2638	5.9512	5.7433	5.2697	6.5886
DIFFERENCE		19	0.334	0.714	0.706	0.669	0.625	0.745
50 FT. TO 25 FT. ANCHOR READING			-0.380					
AV. STRAIN RATE (SEC-1)			-7.72E-10					
25 FT. TO 20 FT. ANCHOR READING				0.008				
AV. STRAIN RATE (SEC-1)				8.12E-11				
20 FT. TO 15 FT. ANCHOR READING					0.037			
AV. STRAIN RATE (SEC-1)					3.76E-10			
15 FT. TO 10 FT. ANCHOR READING						0.044		
AV. STRAIN RATE (SEC-1)						4.47E-10		
10 FT. TO 5 FT. ANCHOR READING							-0.12	
AV. STRAIN RATE (SEC-1)							-1.22E-09	
5 FT. TO 0 FT. ANCHOR READING								0.745
AV. STRAIN RATE (SEC-1)								7.56E-09

K–1 STATION, PANEL 12E, ROOM 12E024

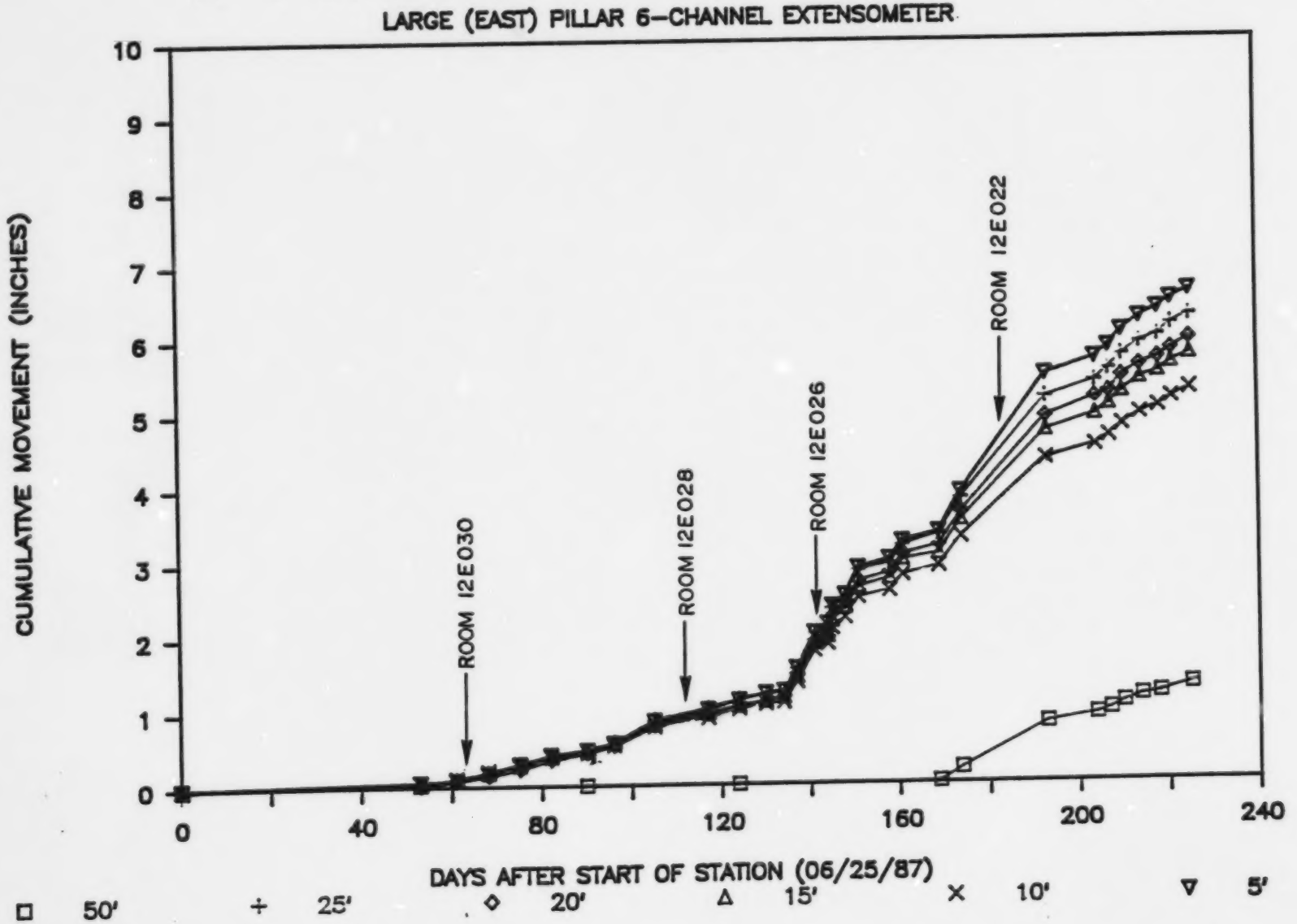


FIGURE 5.6

TABLE 5.8

K-1 STATION, PANEL 12E, ROOM 12E024
LARGE (EAST) PILLAR RADIAL PRESSURE

DATE	DAYS	CH. 5 PRESSURE 20' (PSI)	CH. 6 PRESSURE 15' (PSI)	CH. 7 PRESSURE 10' (PSI)
25-Jun-87	0	2229	2476	2272
26-Jun-87	1	2130	2349	2172
02-Jul-87	7	2105	2324	2147
08-Jul-87	13	2180	2450	2197
14-Jul-87	19	2254	2577	2272
23-Jul-87	28	2378	2728	2322
28-Jul-87	33	2427	2804	2346
04-Aug-87	40	2501	2879	2371
06-Aug-87	42	2526	2904	2396
11-Aug-87	47	2551	2955	2396
17-Aug-87	53	2605	3031	2421
25-Aug-87	61	2675	3081	2446
01-Sep-87	68	2724	3157	2451
08-Sep-87	75	2823	3258	2521
15-Sep-87	82	2873	3308	2546
23-Sep-87	90	2947	3359	2571
29-Sep-87	96	2996	3384	2571
08-Oct-87	105	3046	3439	2586
20-Oct-87	117	3195	3586	2670
27-Oct-87	124	3269	3631	2695
02-Nov-87	130	3294	3636	2695
06-Nov-87	134	3318	3661	2695
09-Nov-87	137	3343	3661	2695
17-Nov-87	145	3615	3914	
20-Nov-87	148	3665	3939	
23-Nov-87	151	3714	54	
30-Nov-87	158	3789		
03-Dec-87	161	75		
11-Dec-87	169			
16-Dec-87	174			
04-Jan-88	193			
15-Jan-88	204			
18-Jan-88	207			
21-Jan-88	210			
25-Jan-88	214			
29-Jan-88	218			
01-Feb-88	221			
05-Feb-88	225			
09-Feb-88	229			

K–1 STATION, PANEL 12E, ROOM 12E024

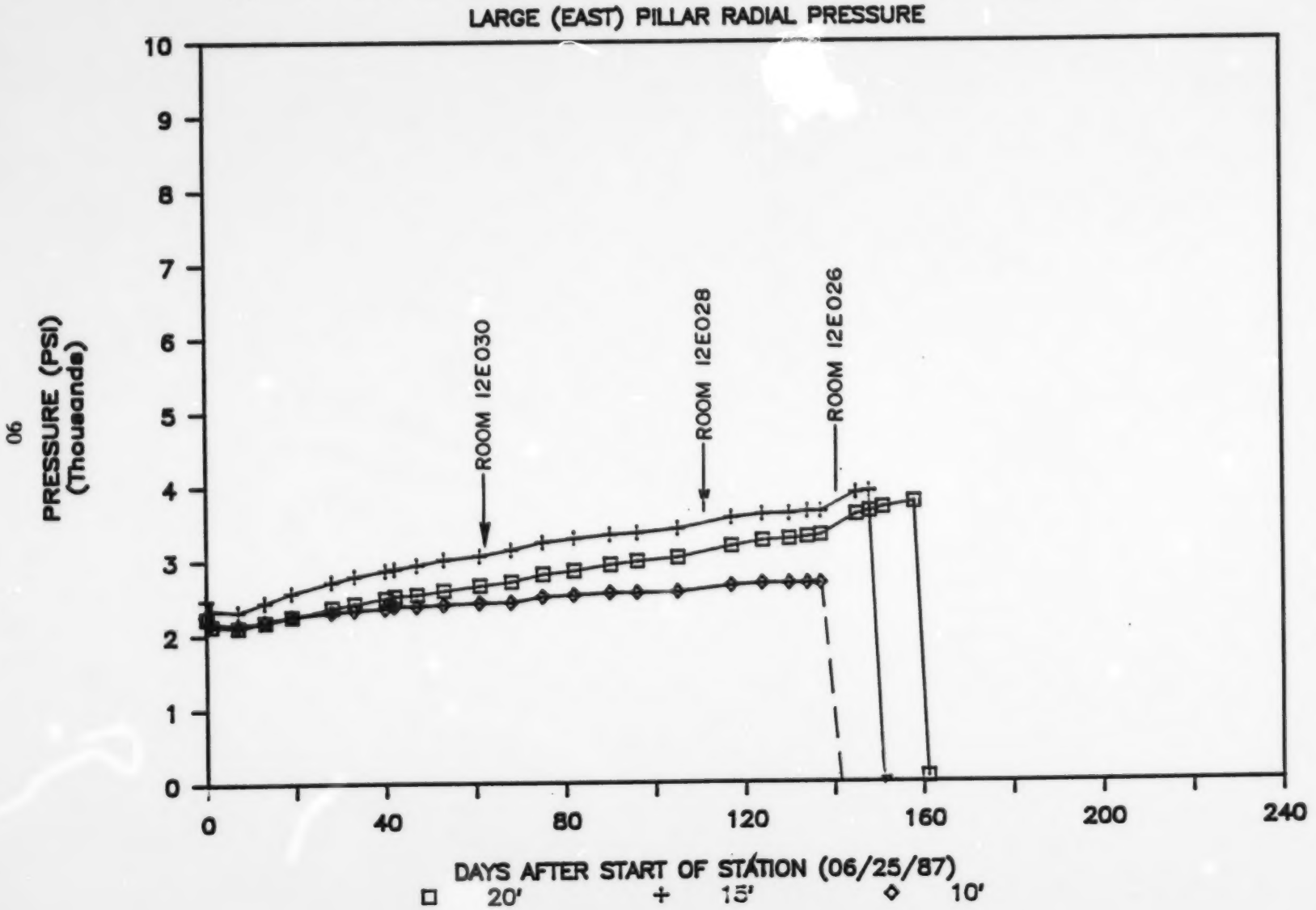


FIGURE 5.7

TABLE 5.9

K-1 STATION, PANEL 12E, ROOM 12E024
LARGE (EAST) PILLAR TANGENTIAL PRESSURE

DATE	DAYS	CHANNEL 4 PRESSURE 50' (PSI)	CHANNEL 2 PRESSURE 20' (PSI)	CHANNEL 0 PRESSURE 15' (PSI)	CHANNEL 11 PRESSURE 10' (PSI)	CHANNEL 9 PRESSURE 5' (PSI)
25-Jun-87	0	-52		2468	1951	2015
26-Jun-87	1	-52			1851	1865
02-Jul-87	7	77		2169	1926	1765
08-Jul-87	13	52		2144	2026	1765
14-Jul-87	19	-52		2144	2126	1765
23-Jul-87	28	-27	2279		2251	1815
28-Jul-87	33	-2	149	2294		
04-Aug-87	40	-2	124	2368		
06-Aug-87	42	-2	124	2418		
11-Aug-87	47	47	124	2493	2426	1830
17-Aug-87	53	47	124	2568	2476	1815
25-Aug-87	61	72	149	2642	2526	1815
01-Sep-87	68	47	149	2767	2601	1865
08-Sep-87	75	47	149	2916	2751	2105
15-Sep-87	82	47	124	3041	2851	2190
23-Sep-87	90	72	174	3141	2916	2165
29-Sep-87	96	72	149	3210	2951	2165
08-Oct-87	105	97	149	3315	3026	2190
20-Oct-87	117	147	250	3614	3351	2641
27-Oct-87	124	172	225	3713	3401	2616
02-Nov-87	130	177	226	3763	3401	2541
06-Nov-87	134	197	225	3788	3426	2516
09-Nov-87	137	222	225	3838	3525	2516
13-Nov-87	141				3916	3657
17-Nov-87	145	371	99	4485	4201	3942
20-Nov-87	148			4560	76	138
23-Nov-87	151			4585		
30-Nov-87	158			4635		
03-Dec-87	161			4650		
11-Dec-87	169			4660		
16-Dec-87	174			4685		
15-Jan-88	204			5482		
18-Jan-88	207			5457		
21-Jan-88	210			5457		
25-Jan-88	214			5432		
29-Jan-88	218			5432		
01-Feb-88	221			5407		
05-Feb-88	225			5407		
09-Feb-88	229			5383		

K–1 STATION, PANEL 12E, ROOM 12E024

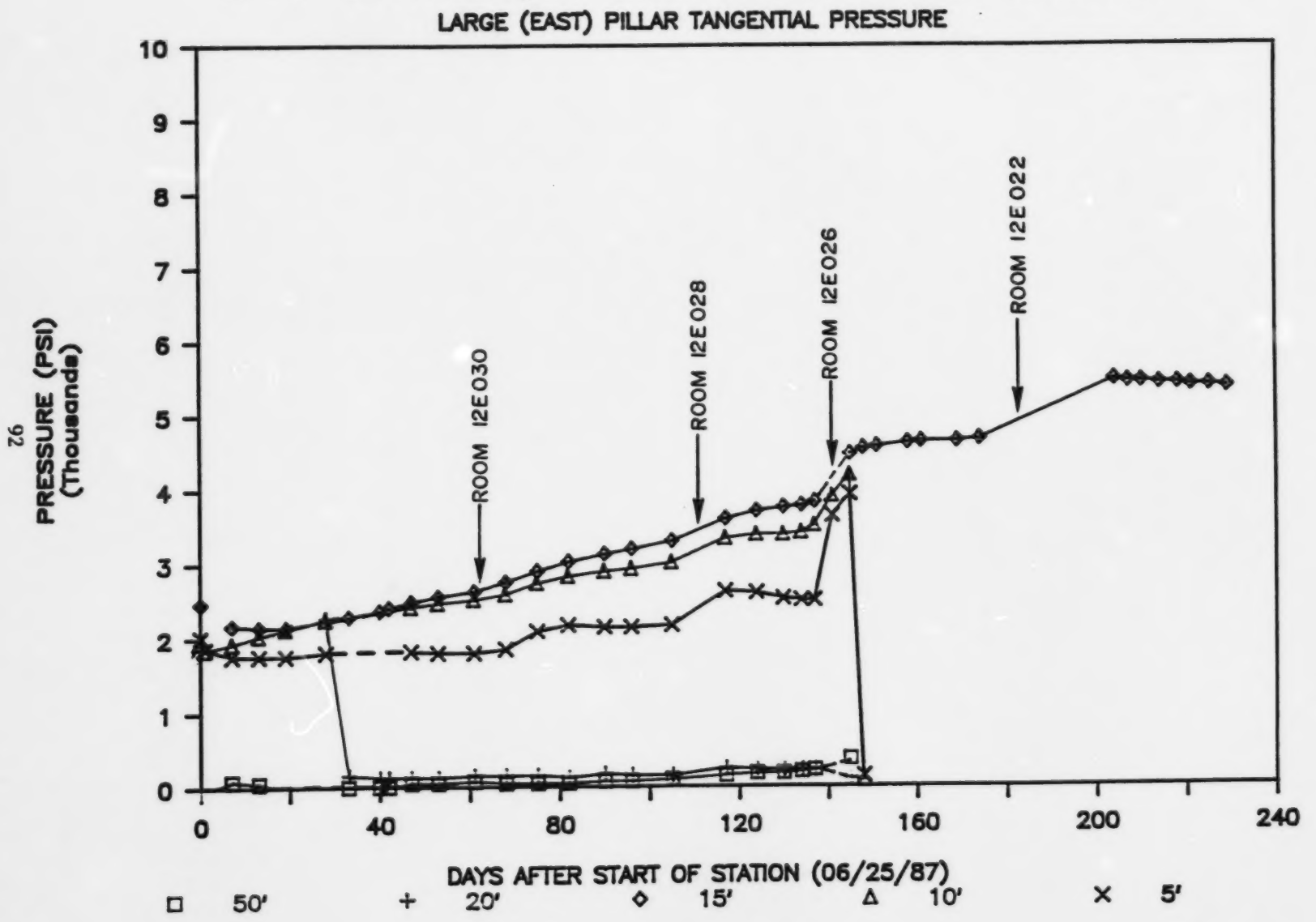


FIGURE 5.8

TABLE 5.10

K-1 STATION, PANEL 12E, ROOM 12E024
LARGE (EAST) PILLAR LATERAL PRESSURE

DATE	DAYS	CHANNEL 3 PRESSURE 50' (PSI)	CHANNEL 1 PRESSURE 20' (PSI)	CHANNEL 12 PRESSURE 15' (PSI)	CHANNEL 10 PRESSURE 10' (PSI)	CHANNEL 8 PRESSURE 5' (PSI)
25-Jun-87	0	2787	2683	2269	2268	219
26-Jun-87	1	2623	2532	2144	2193	95
02-Jul-87	7	2339	2279	2094	2268	60
08-Jul-87	13	2239	2229	2169	2393	50
14-Jul-87	19	2214	2229	2244	2518	70
23-Jul-87	28	2189	2244	2369		70
28-Jul-87	33	2189	2305			
04-Aug-87	40	2189	2330			
06-Aug-87	42	2189	2355			
11-Aug-87	47	2189	2380	2594		45
17-Aug-87	53	2214	2406	2644	2844	45
25-Aug-87	61	2214	2456	2718	2894	70
01-Sep-87	68	2239	2506	2768	2944	45
08-Sep-87	75	2289	2582	2893	3094	20
15-Sep-87	82	2314	2652	2968	3169	20
23-Sep-87	90	2339	2734	3043	3194	20
29-Sep-87	96	2364	2759	3093	3219	20
08-Oct-87	105	2413	2834	3168	3269	25
20-Oct-87	117	2488	3011	3368	3520	35
27-Oct-87	124	2538	3087	3443	3570	45
02-Nov-87	130	2563	3127	3493	3570	45
06-Nov-87	134	2588	3157	3518	3595	45
09-Nov-87	137	2613	3188	3543	3620	45
13-Nov-87	141			3768	3945	45
17-Nov-87	145	2762	3591	4043	4196	45
20-Nov-87	148	2787	34	4143	215	
23-Nov-87	151	2812		4193		
30-Nov-87	158	2887		4318		
03-Dec-87	161	2912		4343		
11-Dec-87	169	2962		4368		
16-Dec-87	174	2987		4418		
04-Jan-88	193			4493		
15-Jan-88	204			4668		
18-Jan-88	207			4668		
21-Jan-88	210			4668		
25-Jan-88	214			4693		
29-Jan-88	218			4668		
01-Feb-88	221			4668		
05-Feb-88	225			4668		
09-Feb-88	229			4668		

K-1 STATION, PANEL 12E, ROOM 12E024

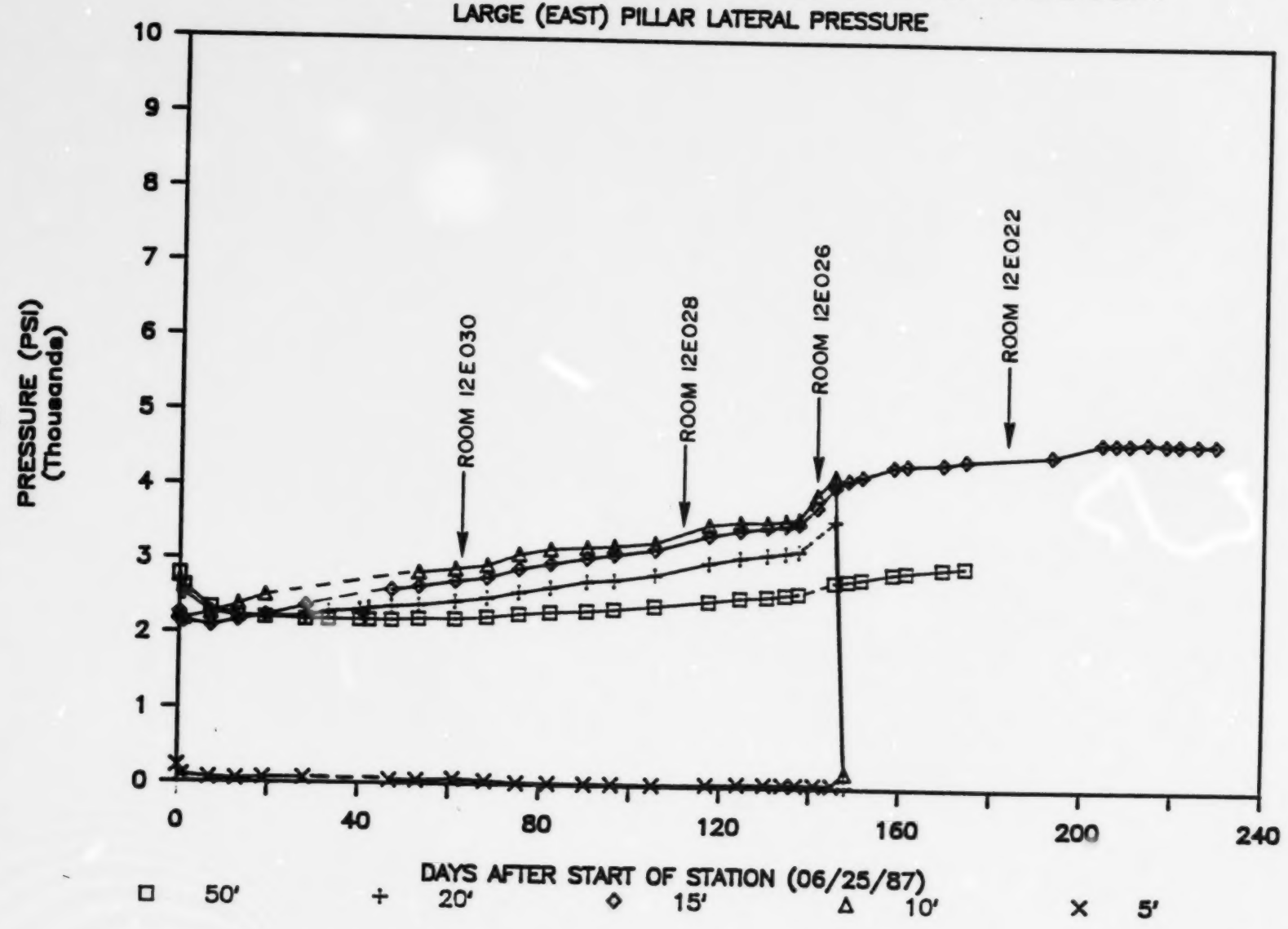


FIGURE 5.9

5.4 Small (West) Pillar Instrumentation

The following tables and figures record data for the small (west) pillar instrumentation in Room 12E024.

TABLE 5.11

K-1 STATION, PANEL 12E, ROOM 12E024
SMALL (WEST) PILLAR TANGENTIAL PRESSURE

DATE	DAYS	CHANNEL 13 PRESSURE 15' (PSI)	CHANNEL 15 PRESSURE 10' (PSI)	CHANNEL 17 PRESSURE 5' (PSI)
25-Jun-87	0	2317	2037	2596
26-Jun-87	1	2217	1957	2547
02-Jul-87	7	2192	2032	2671
08-Jul-87	13	2267	2157	2770
14-Jul-87	19	2367	2257	2845
23-Jul-87	28	2492	2407	2944
11-Aug-87	47	2667	2607	3068
17-Aug-87	53	2692	2657	3093
25-Aug-87	61	2767	2707	3143
01-Sep-87	68	2842	2782	3193
08-Sep-87	75	3067	3082	3516
15-Sep-87	82	3167	3182	3541
23-Sep-87	90	3217	3232	3516
29-Sep-87	96	3242	3257	3516
08-Oct-87	105	3317	3332	3550
20-Oct-87	117	3767	3857	4013
27-Oct-87	124	3792		3938
02-Nov-87	130	3792		3888
06-Nov-87	134	3792		3888
09-Nov-87	137	3817		3888
13-Nov-87	141	5116	5533	136
17-Nov-87	145	42	5783	136
20-Nov-87	148	destroyed	5708	destroyed
23-Nov-87	151		5658	
30-Nov-87	158		5583	
03-Dec-87	161		5558	
11-Dec-87	169		5508	
16-Dec-87	174		5508	
04-Jan-88	193		5533	
15-Jan-88	204		6033	
18-Jan-88	207		5983	
21-Jan-88	210		5933	
25-Jan-88	214		5883	
29-Jan-88	218		5833	
01-Feb-88	221		5783	
05-Feb-88	225		5758	
09-Feb-88	229		5708	

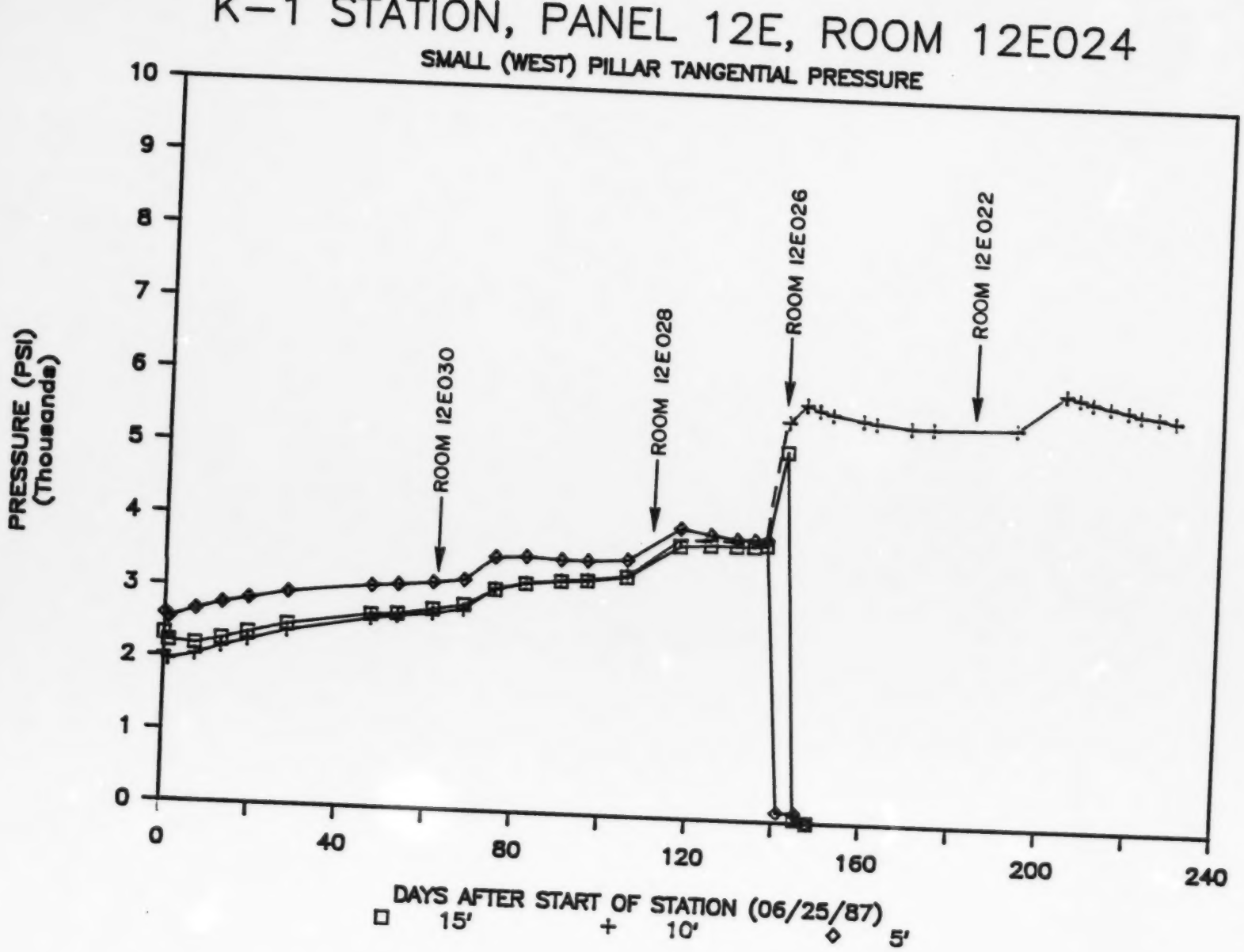

K-1 STATION, PANEL 12E, ROOM 12E024
SMALL (WEST) PILLAR TANGENTIAL PRESSURE
PRESSURE (PSI)
(Thousands)
10
9
8
7
6
5
4
3
2
1
0
ROOM 12E030
ROOM 12E028
ROOM 12E026
ROOM 12E022
0
40
80
120
160
200
240
DAYS AFTER START OF STATION (06/25/87)
□ 15'
+ 10'
◇ 5'

FIGURE 5.10

TABLE 5.12

K-1 STATION, PANEL 12E, ROOM 12E024
SMALL (WEST) PILLAR LATERAL PRESSURE

DATE	DAYS	CHANNEL 14 PRESSURE 15' (PSI)	CHANNEL 16 PRESSURE 10' (PSI)	PRESSURE 5' (PSI)
25-Jun-87	0	2396	2394	NO TRANS-
26-Jun-87	1	2295	2294	DUCER
02-Jul-87	7	2346	2294	
08-Jul-87	13	2496	2394	
14-Jul-87	19	2621	2488	
23-Jul-87	28	2771	2592	
11-Aug-87	47	2972	2766	
17-Aug-87	53	3022	2816	
25-Aug-87	61	3097	2865	
01-Sep-87	68	3147	2915	
08-Sep-87	75	3323	3089	
15-Sep-87	82	3423	3163	
23-Sep-87	90	3498	3188	
29-Sep-87	96	3523	3188	
08-Oct-87	105	3473	3238	
20-Oct-87	117	3874	3461	
27-Oct-87	124	3949	3461	
02-Nov-87	130	3999	3436	
06-Nov-87	134	4024	3436	
09-Nov-87	137	4049	3436	
13-Nov-87	141	4500	4131	
17-Nov-87	145	-34	85	
20-Nov-87	148	destroyed	destroyed	
23-Nov-87	151			
30-Nov-87	158			
03-Dec-87	161			
11-Dec-87	169			
16-Dec-87	174			
04-Jan-88	193			
15-Jan-88	204			
18-Jan-88	207			
21-Jan-88	210			
25-Jan-88	214			
29-Jan-88	218			
01-Feb-88	221			
05-Feb-88	225			
09-Feb-88	229			
05-Feb-88	225			
09-Feb-88	229			

K-1 STATION, PANEL 12E, ROOM 12E024

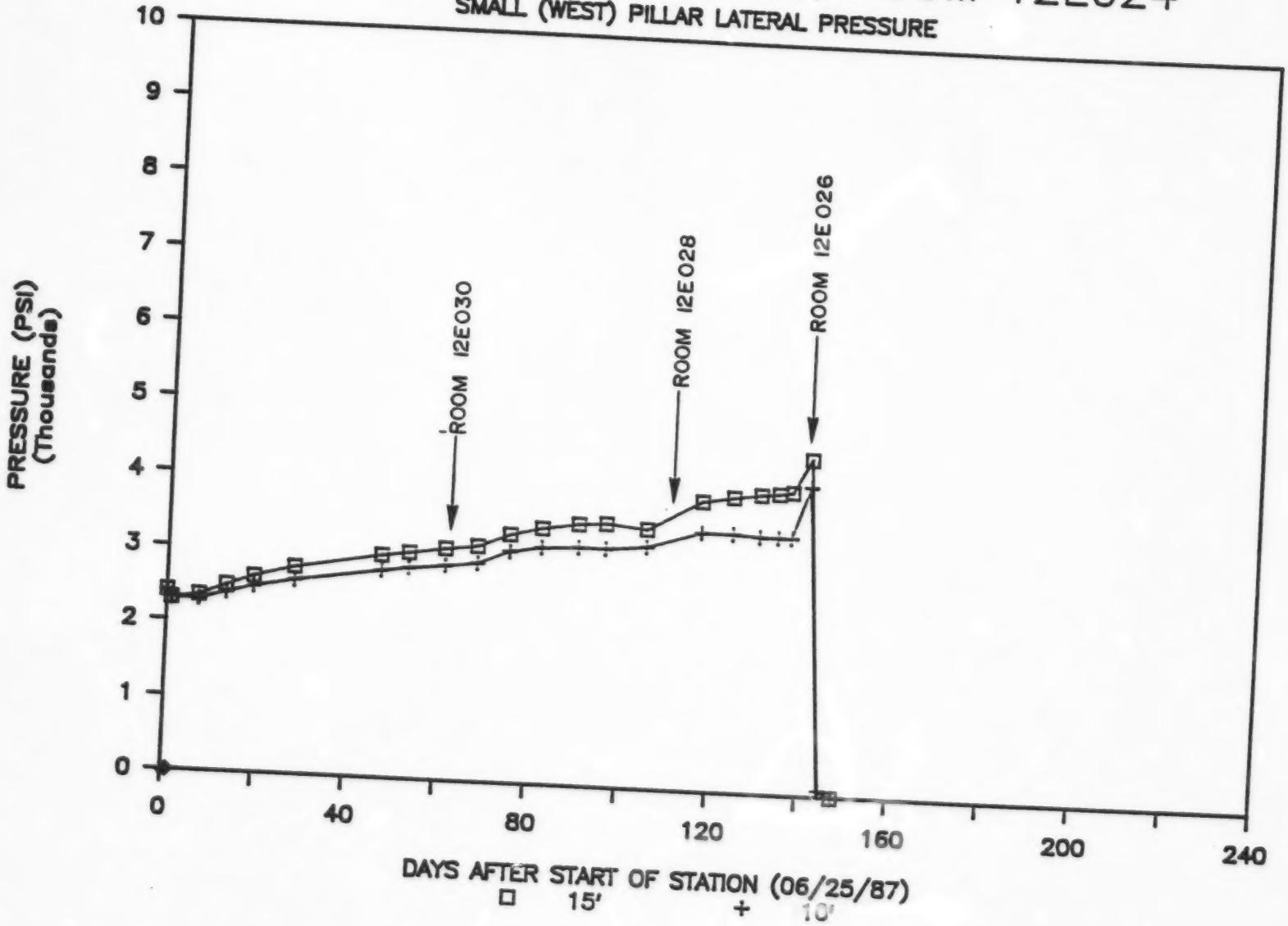


FIGURE 5.11

5.5 Photographs of Installation

The following photographs show the instrumentation installations at the Rock Mechanics Station in Room 12E024, Panel 12E, K-1 Mine.

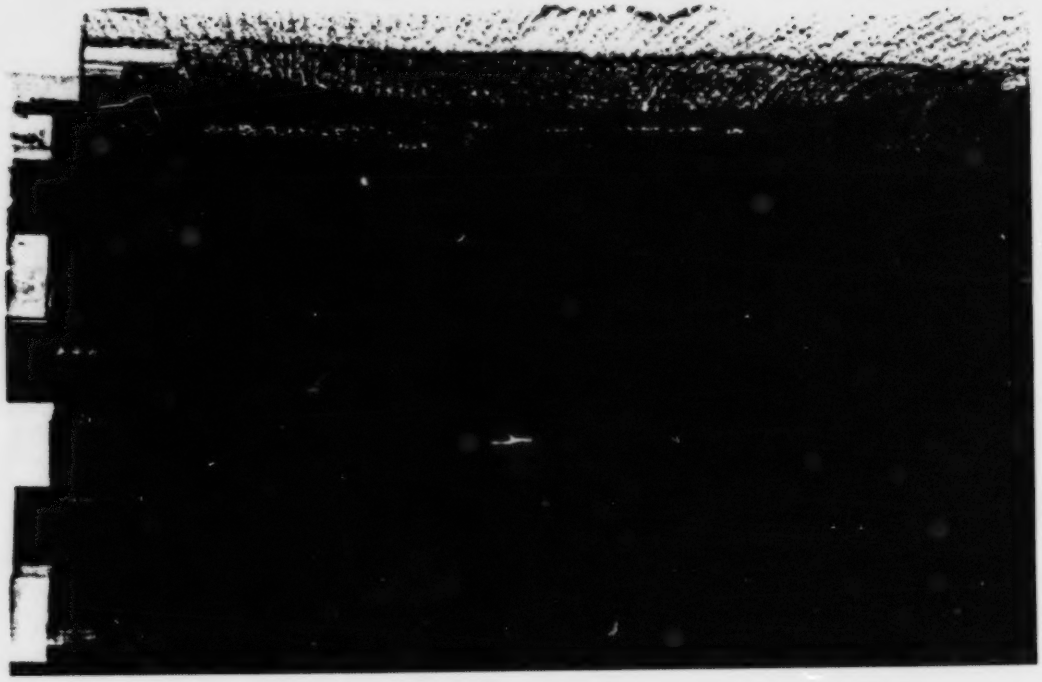


PHOTO 5.1: K-1 Station showing timber cribbing on left, (east) large pillar wall cells and horizontal closure meter in background, vertical closure meter installed in roof and AC/DC transformer/junction box mounted on posts. Photo taken looking east.

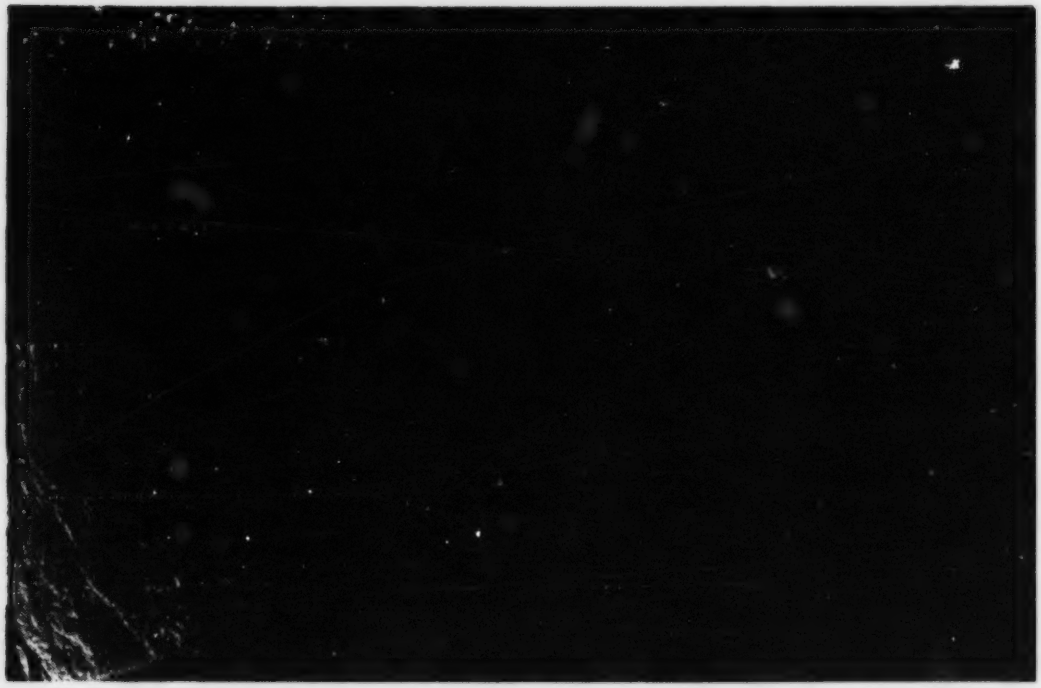


PHOTO 5.2: K-1 Station showing (east) large pillar wall cells, horizontal closure meter and pressure cell panels. Photo taken looking southeast.

PHOTO 5.3: K-1 Station showing (east) large pillar wall cells, horizontal closure meter and pressure cell panels. Photo taken looking northeast.

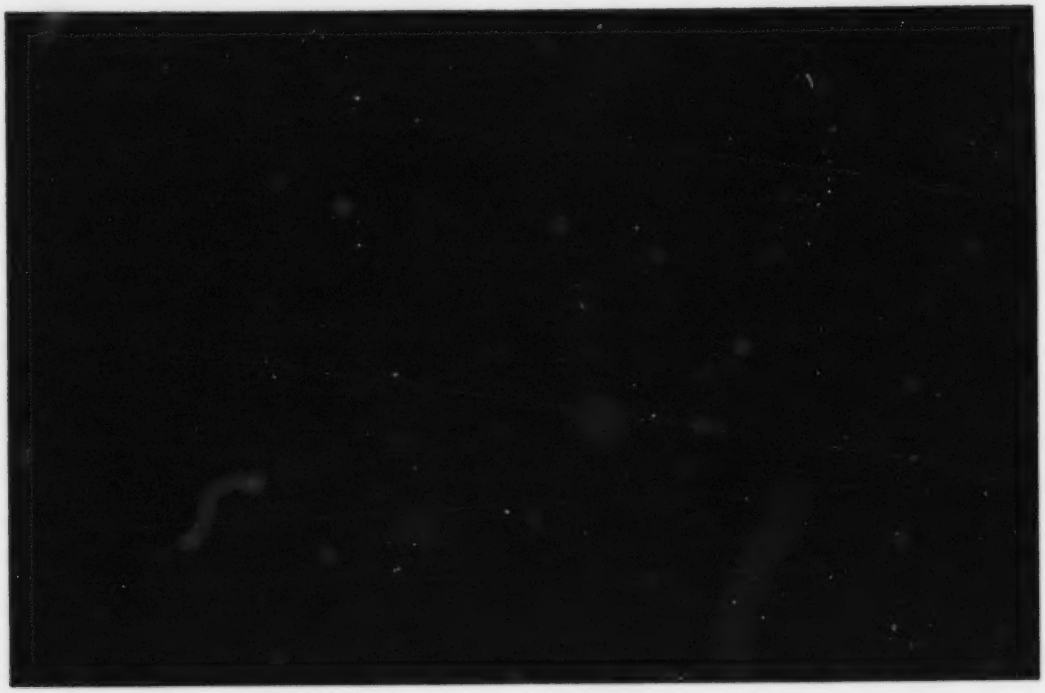


PHOTO 5.4: K-1 Station showing 6-point wall extensometer installed in (east) large pillar with anchor point references. Photo taken looking east.

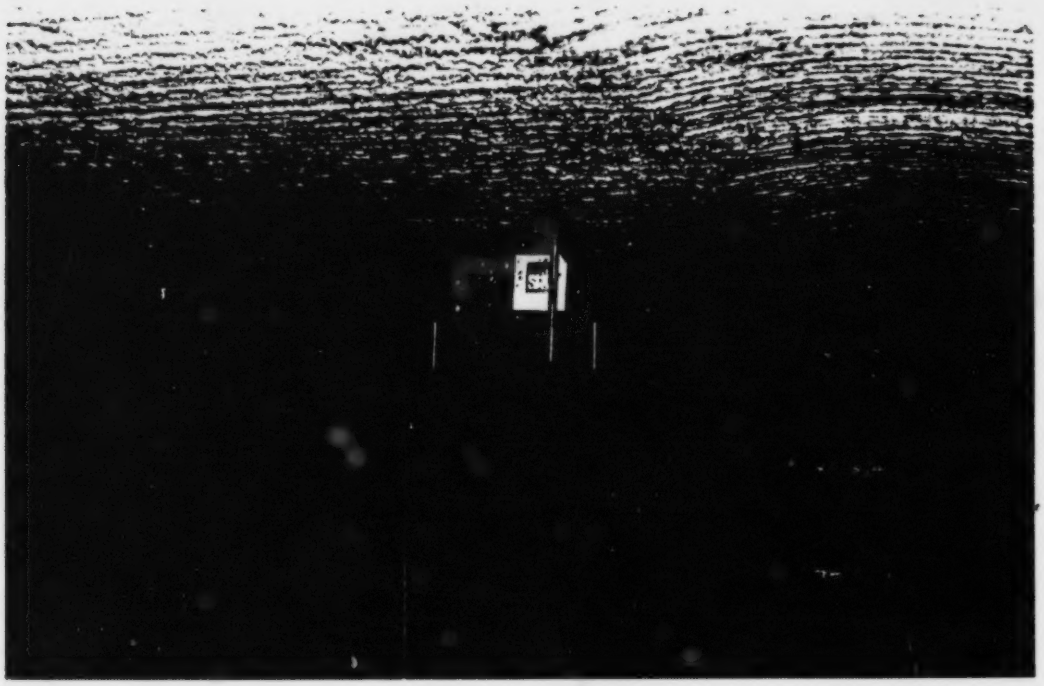


PHOTO 5.5: K-1 Station showing vertical closure meter installed in roof. Note cribbing protection in background. Photo taken looking north.

PHOTO 5.6: K-1 Station showing AC/DC transformer/junction box. Note loose potash covering/protection data cables and timber cribbing. Photo taken looking northwest.

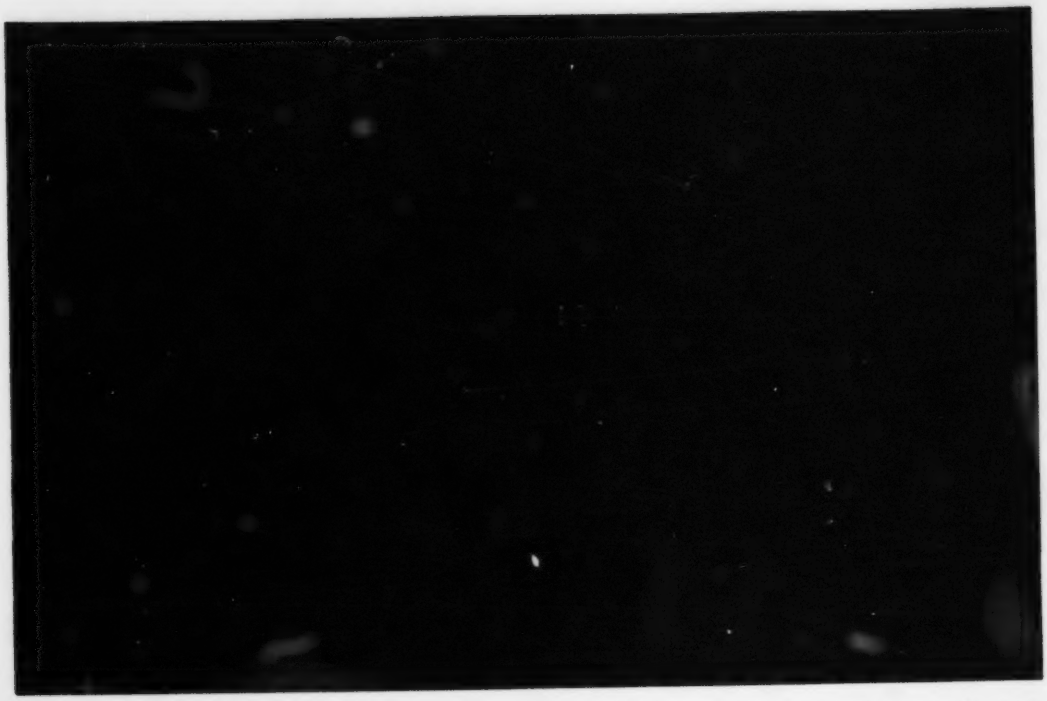


PHOTO 5.7: K-1 Station showing pressure cells, pressure cell panel and horizontal closure wire installed in (west) small pillar. Photo taken looking northwest.

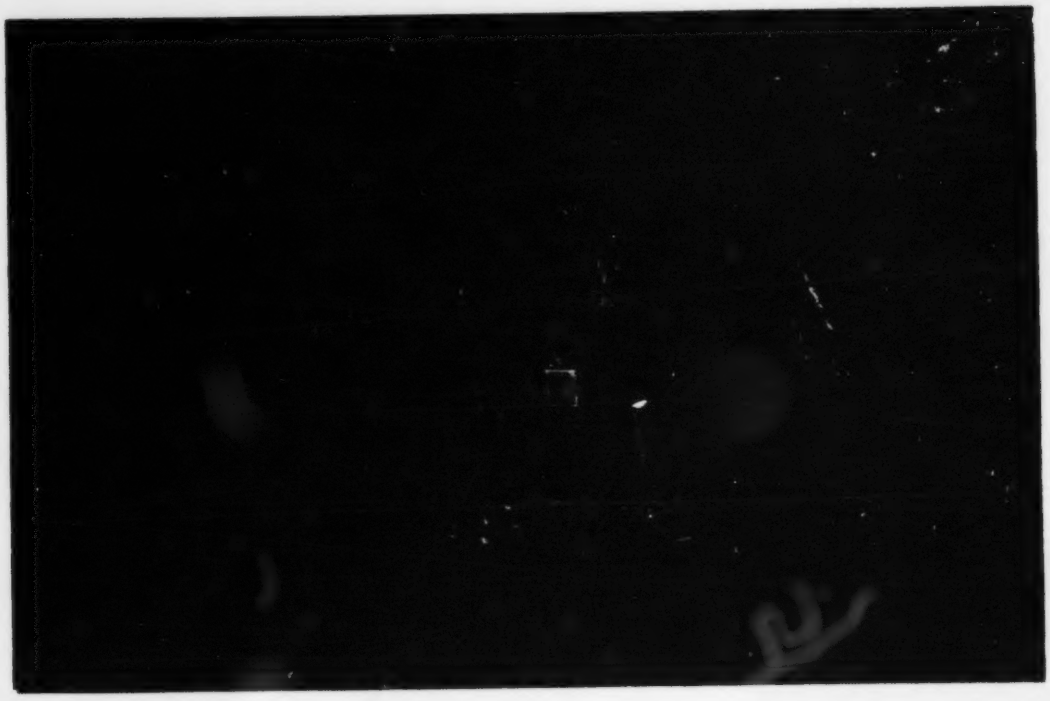


PHOTO 5.8: K-1 Station showing radial pressure cells and pressure cell panel installed in (east) large pillar cut-out. Photo taken looking south.

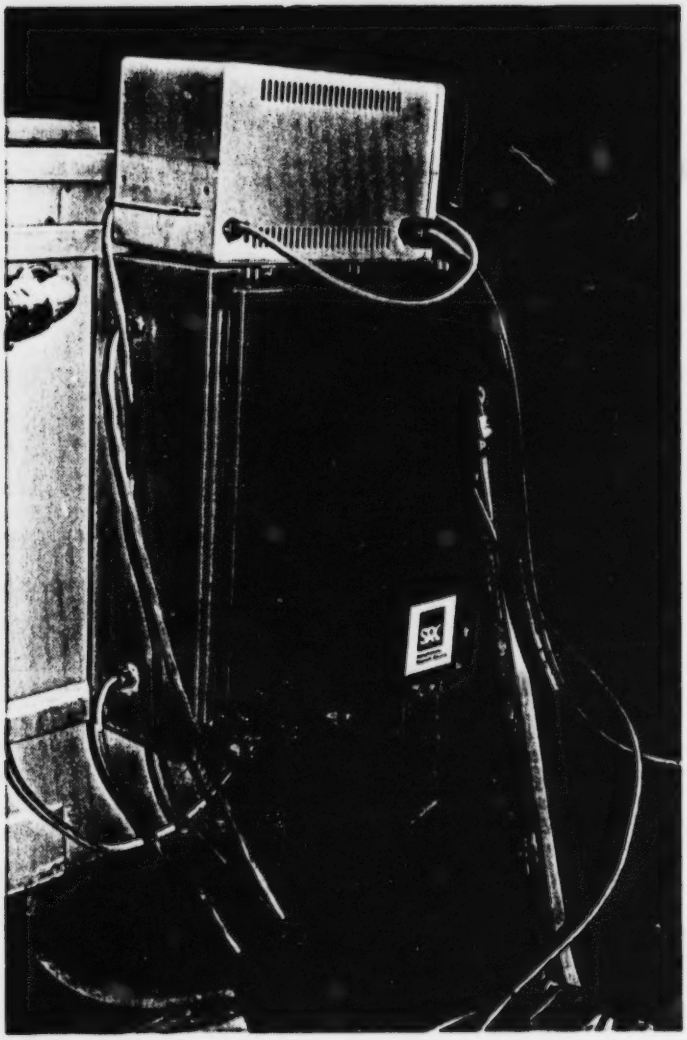


PHOTO 5.9: K-1 Station showing power/voltage booster component of data acquisition system mounted on top of multiplexing unit. Location 1147 Drive.

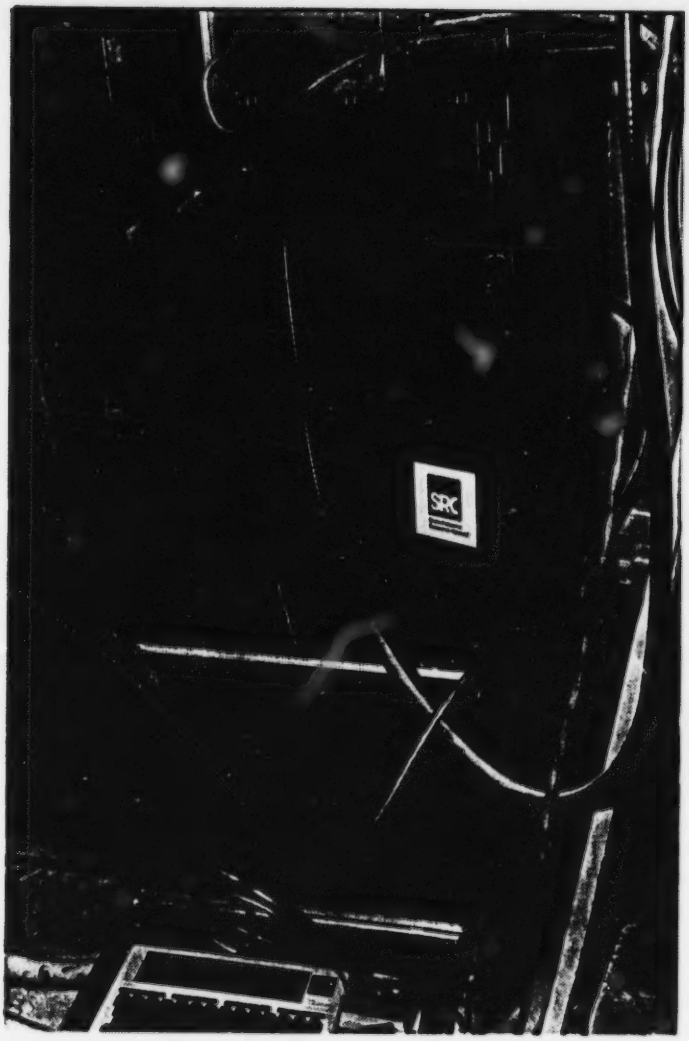


PHOTO 5.10: K-1 Station showing multiplexing unit and (portable) computer components of data acquisition system. Location 1147 Drive.

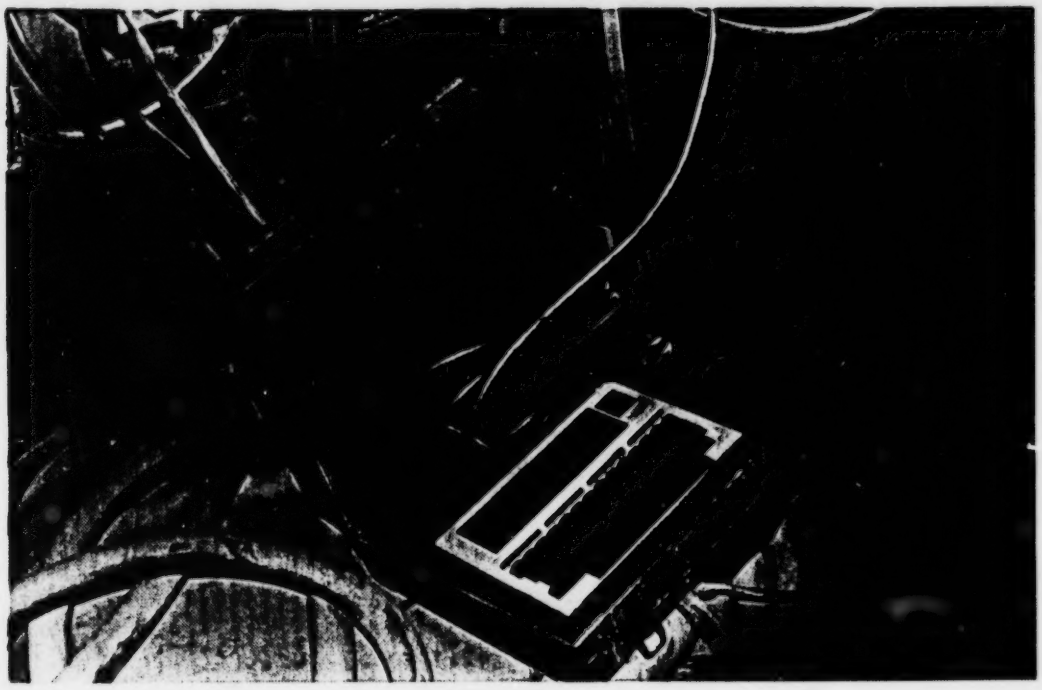


PHOTO 5.11: K-1 Station showing portable computer component of data acquisition system.

SECTION 6.0

6.0 INTACT ROCK SPECIMEN TESTING

The salt rock specimen testing program was carried out to determine the mechanical properties of two potash ores from the IMC minesite. A limited number of creep tests was also done.

Laboratory testing was conducted by the University of Waterloo on two types of rock salt from IMC. The work was performed under IMC purchase orders K17-00028 and K17-00169.

The two salts tested were Panel 13H sylvinite and Panel 12E carnallite. Panel 13H sylvinite had approximately 0.9% carnallite content and the Panel 12E carnallite had approximately 18.5% carnallite content.

6.1 Sample Collection: 100MM Diameter Cores

Sample coring of low-carnallitic sylvinite samples at K-2 mine, Panel 13H, Room 13H040 was completed in January 1987. Sample coring of carnallitic sylvinite samples at K-1 mine, Panel 12E, Room 12E024 was completed in June 1987.

The coring locations were selected by IMC personnel in the smaller, yielding pillar at both sites and orientated so as to take core from the ore bed.

A Boyles, compressed air driven, diamond drill was used to core the specimens. The coring bit and, hence, core barrel had an inside diameter of 100 MM (4 inches). This diameter was chosen to provide specimens suitable for the size of the triaxial cells at the University of Waterloo WATSALT testing facilities.

Samples were drilled at the K-2 site using saturated brine. The quality of the core samples recovered was not good. Drill availability and mining progress led to a decision to substitute another sample of "40" bed ore, Sample "IMC1", for the initial Panel 13H sylvinite.

6.2 Sample Preparation and Testing

The WATSALT laboratory at the University of Waterloo is equipped with specially designed and built testing equipment for performing triaxial testing on 50 to 100 mm diameter rock core samples. A systematic methodology has been developed for working with saltrock materials.

6.3 Brittle Yield Testing Results

The brittle yield testing results are shown in Table 6.1. A parabolic equation has been developed to fit the brittle yield data using the coefficients "R" and "M".

The equation is of the form:

$$\sigma_1 = (\sigma_c/2)\left[(1-RM) + \{(1+RM)^2 + 4M(\sigma_3/\sigma_c)\}^{0.5}\right]$$

where: $R = -(\sigma_T/\sigma_c)$

σ_T = Tensile Strength

σ_c = Unconfined Compressive Strength (UCS)

M = Constant

TABLE 6.1

IMC FAILURE ENVELOPES

SALT SPECIMEN ORIGIN	SPECIMEN NUMBER	σ_3 (MPa)	σ_1 (MPa)	$\dot{\epsilon}$ (SEC-1)	E (GPa)
PANEL 13H	SYL20A	-1.00	0.00	1E-04	
SAMPLE "IMC1"	SYL64	0.00	12.99	2E-04	3.75
	SYL53	0.50	25.00	2E-04	
	SYL20B	1.00	29.94	2E-04	
	SYL41	2.00	37.59	2E-04	
PANEL 12E	CARN5	-0.94	0.00	1E-04	
SAMPLE CCH5820	CARN6	-1.17	0.00	1E-04	
	CARN3	0.00	12.43	1E-04	1.86
	CARN4	1.00	20.72	5E-04	
	CARN2	2.00	25.75	3E-04	
	CARN1	3.00	22.36*	3E-04	

* CONFINING PRESSURE (σ_3) WAS LOST DURING TEST.

NOTE: SAMPLE "IMC1" CARNALLITE CONTENT = 0.9%.
SAMPLE "CCH5820" CARNALLITE CONTENT = 18.5%.

The coefficients calculated for Panel 13H sylvinite are as follows:

R = 0.079

M = 500

This curve is shown as calculated fit 1 in Figure 6.1.

The high value of "M" is due to the shape of the test data curve; the UCS is lower than would be expected based on the other test results. The constants "M" and "R" were recalculated assuming the UCS of a previously tested and reported IMC sylvinite ore. This ore had a UCS of 18.04 MPa.

The higher UCS value smooths the curve allowing it to be fit more correctly with a parabolic equation. The apparent low UCS value may be attributable to sampling and stress relief microcracking. The new constants, assuming an UCS of 18.04 MPa are as follows:

R = 0.0554

M = 45

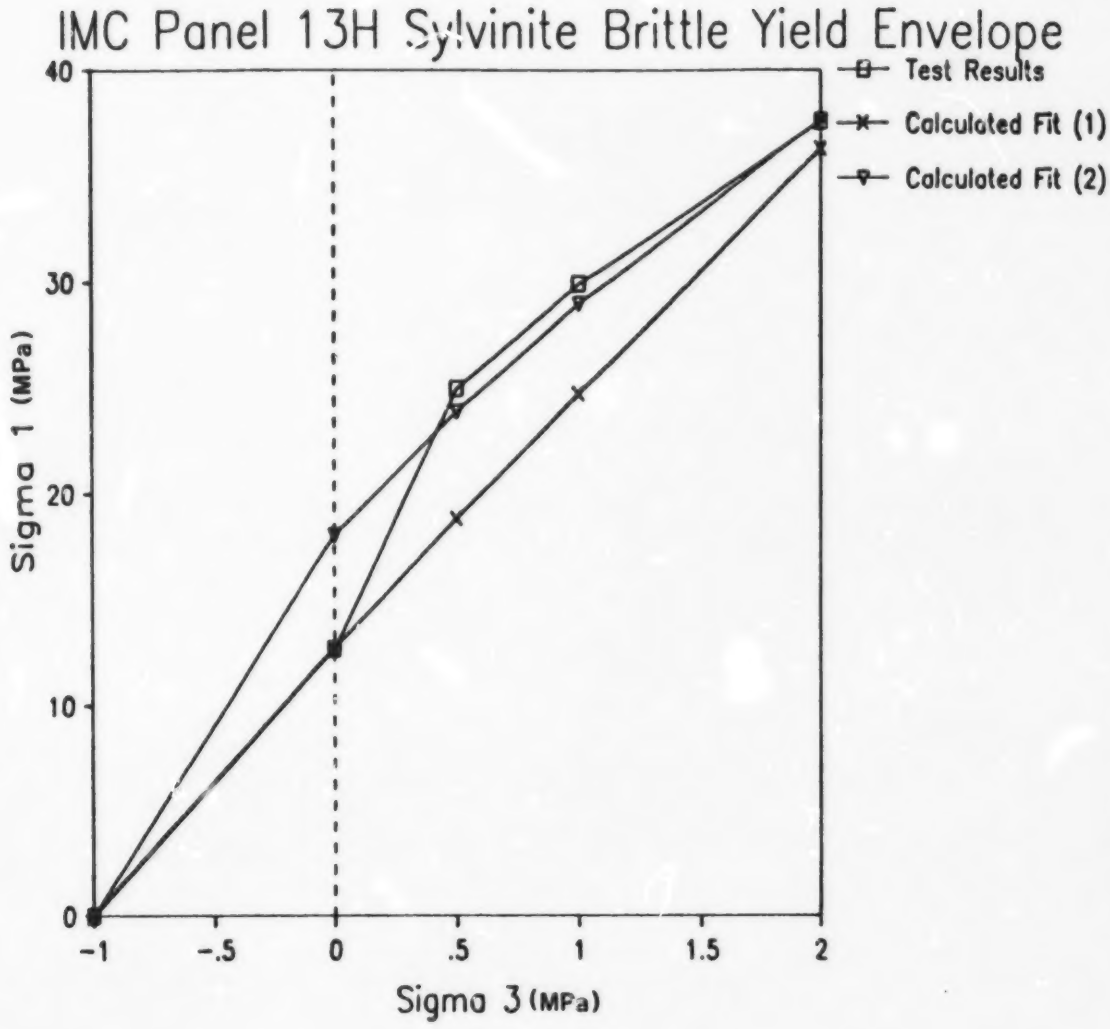
This curve is shown as calculated fit 2 in Figure 6.1.

The curve fit coefficients for Panel 12E sylvinite are as follows:

R = 0.085

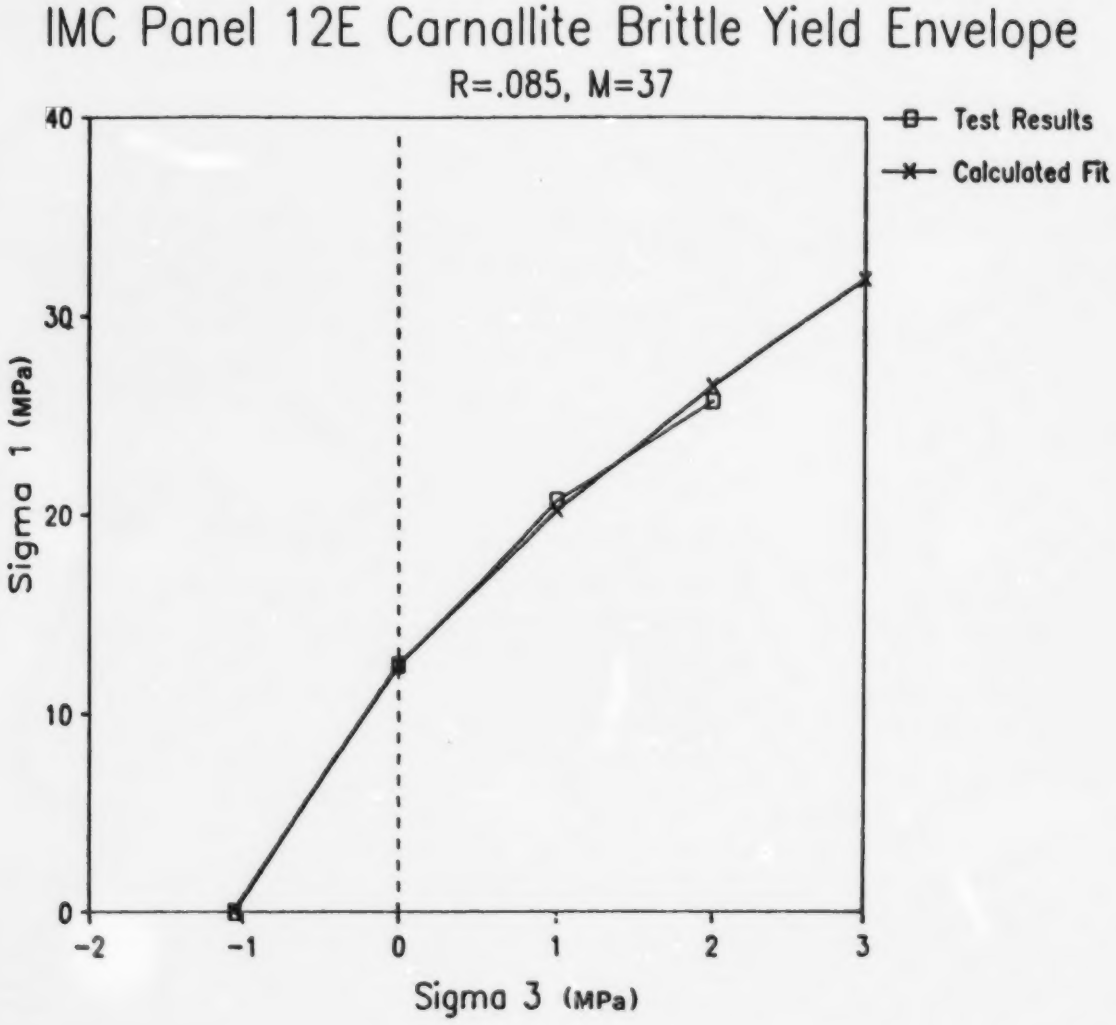
M = 37

The two tensile strength values were averaged in the calculation of "R". The data is shown graphically on Figure 6.2. The results of the two brittle yield test programs are summarized on Figure 6.3



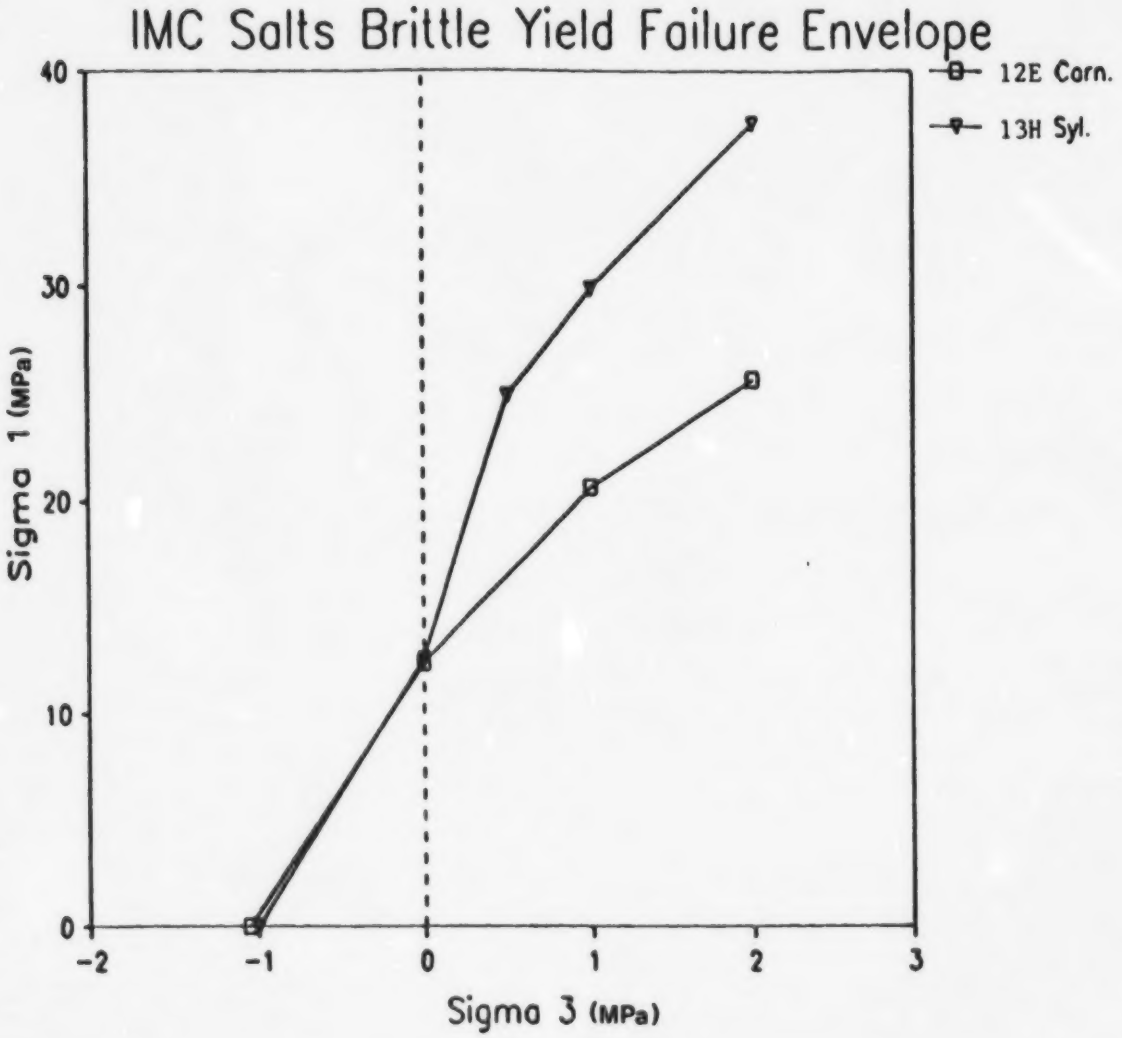
Brittle Yield Test Results, IMC Panel 13H Sylvinite

FIGURE 6.1



Brittle Yield Test Results, IMC Panel 12E Carnallite

FIGURE 6.2



Brittle Yield Test Results, IMC Salts

FIGURE 6.3

6.4 Intact Rock Creep Testing Results

Due to the limited scope of the program, only one multistage creep test was performed on the low-carnallitic sylvinite, sample "IMC1".

The creep test data are listed in Table 6.2 and presented graphically in Figure 6.4. A linear regression analysis of the data in a log/log plane was performed to the power law equation of the form:

$$\dot{\epsilon} = A\ (\sigma_1 - \sigma_3)^n$$

Two sets of regression constants for the specimen tested are presented in Table 6.3. The first is a regression of all five data points listed. The second is a regression of the last four data points listed in Table 6.2. The first point is somewhat higher than would be expected from the other data points. The specimen may not have been in true steady state creep before the stresses were changed.

TABLE 6.2
IMC CREEP TEST RESULTS

SALT SPECIMEN	SPECIMEN NUMBER	(MPa)	(MPa)	(MPa)	(SEC-1)
LOW-CARNALLITIC SYLVINITE	IMC1	34.80	16.80	18.00	6.13E-09
		27.30	10.30	17.00	1.41E-09
		36.50	17.90	18.60	3.12E-09
		37.70	17.30	20.40	5.32E-09
		38.40	16.80	21.60	6.30E-09

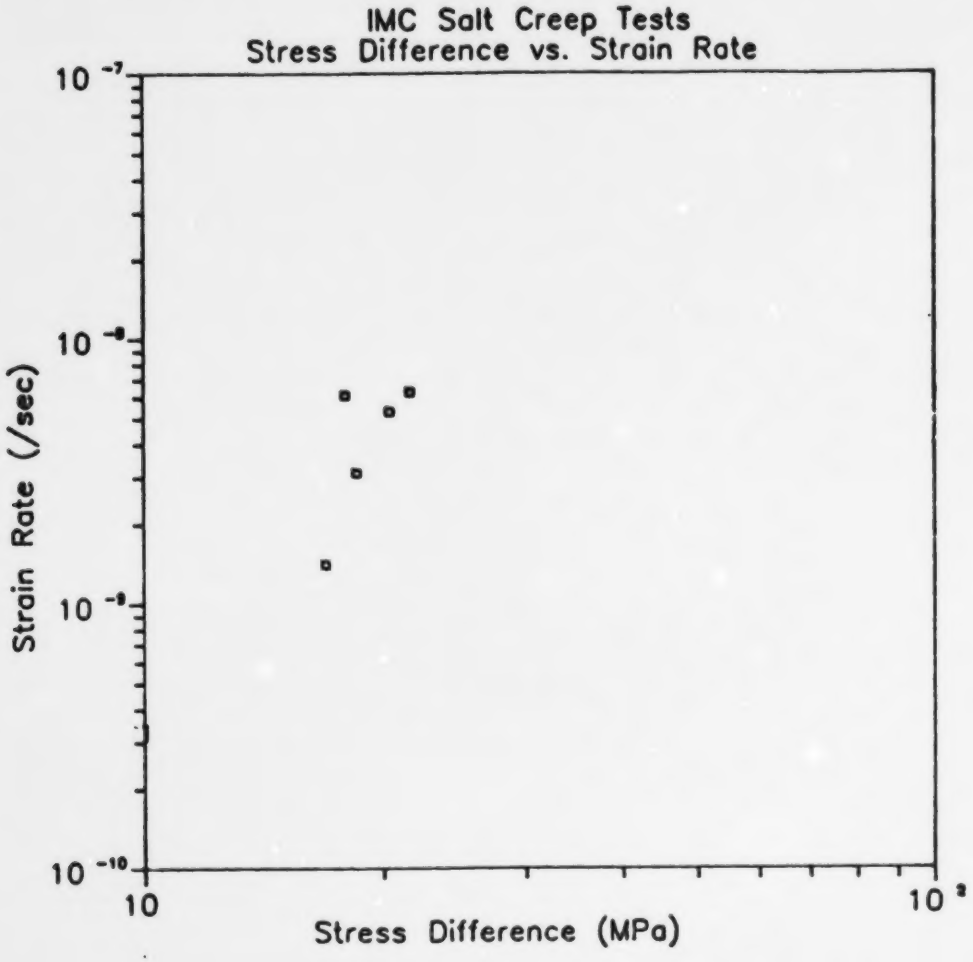

IMC Salt Creep Tests
Stress Difference vs. Strain Rate
Strain Rate (/sec)
10 -7
10 -8
10 -9
10 -10
10
10 2
Stress Difference (MPa)

FIGURE 6.4

TABLE 6.3

CREEP TEST REGRESSION CONSTANTS

SPECIMEN	n	A (SEC-1)
INC1(5)	4.76	3.19E-15
INC1(4)	6.29	2.81E-17

SECTION 7.0

7.0 EVALUATION OF FIELD MEASUREMENT DATA

7.1 Panel 13H

The reactions of the test site in Room 13H040 to mining activities in Panel 13H are apparent from Figure 4.4. As the mining progressed towards the test site, "waves" of stress passed through with each new room and induced accelerated closure. The oriented pressures in hydraulic pressure cells in pillars increased with each wave (Figures 4.12, 4.13, 4.14 and 4.15), but no major reaction to "reloading" was observed. It is anticipated that excavation of several additional rooms will be required before full reloading takes effect.

Two time periods from recorded history of the test site were selected for evaluation.

(1) Near virgin ground state, days 104 to 153, Drawing No. MPC-0037.

(2) Partly reloaded state, days 252 to 301, Drawing No. MPC-0035.

Each drawing includes the following information:

* Excavation map at the end of period;
* Oriented tangential, lateral and radial pressures at the end of period;
* Difference between tangential and radial pressures at the end of period;
* Ratio between average and lateral pressures at the end of period;
* Average strain rates over the period.

If we assume that the tangential and radial pressures near opening in the large pillar are close to major and minor principal stresses, we can compare the ratios of stress differences and strain rates as follows:

	Mearsured		
	Period 2 (Days 252 to 301)	Period 1 (Days 104 to 153)	Ratio
Stress Difference at 5', $\Delta\sigma_i$ (MPa)	29.0	23.4	1.24
Average Strain Rate 5' to 10', $\dot{\epsilon}_i$ (s^{-1})	4.6×10^{-9}	5.8×10^{-10}	7.93

Assuming a power law (equation 14), we can take

$$n = \frac{\log 7.93}{\log 1.24}$$

$$= 9.63$$

The calculated exponent indicates that, at the time of the measurements, the pillars were still in a highly transient state of stress.

7.2 Panel 12E

The reactions of the test site in Room 12E024 to mining activities in Panel 12E are apparent from Figure 5.4. As with Panel 13H, as mining progresses towards the test site, "waves" of stress passed through with each new room and induced accelerated closure. The oriented pressures in hydraulic pressure cells in the pillars increased with each wave (Figures 5.7, 5.8, 5.9, 5.10 and 5.11), but no major reduction to "reloading" was observed.

Three time periods from the recorded history of the test site were selected for evaluation.

(1) Near virgin ground state, days 53 to 68, Drawing No. MPC-0036.

(2) Partly reloaded state, days 90 to 105, Drawing No. MPC-0038.

(3) Partly reloaded state, days 210 to 229, Drawing No. MPC-0034.

Each drawing includes the following information where applicable;

* Excavation map at the end of period;
* Oriented tangential, lateral and radial pressures at the end of period;
* Ratio between average and lateral pressures at the end of period;
* Average strain rates over the period.

The recorded data reflects highly transient behaviour and, since, most of the pressure cells have failed at approximately 148 days, the pressure readings are deemed unreliable. Due to the failure of the pressure cells, no further measured data is available and, hence, no attempt will be made to interpret the data further.

SECTION 8.0

8.0 RESULTS AND CONCLUSIONS

Based on the objectives of the program, the results and conclusions are as follows:

Phase I - Rock Property Characterization

1) Mechanical properties of carnallitic sylvinite and low-carnallitic sylvinite, representing two types of materials contained within the Esterhazy ore zone, were tested. The brittle yield properties, unconfined compressive strengths, tensile strength and the Young's modulus are tabulated in Subsection 6.3. A staged creep test was performed on a sample of low carnalitic sylvinite and results are tabulated in Subsection 6.4.

2) The long term rheological difference between the sylvinite and the carnallite types of ore could not be determined on the basis of in situ test conducted. The tests at both sites had to be terminated before the reloading and the Steady State occurred. No reloading, due to the collapse of overburden strata, was observed during the monitoring periods. The laboratory data are not available for the lower range of stresses compatible with the range of long-term stresses in situ.

Phase II - Monitoring of Sites in Active Mining Panels

The test site in Room 13H040 was monitored for 353 days, and the test site in Room 12E024 for 229 days. The former was not equipped with the remote monitoring system and could not be accessed after February 8, 1988, due to unsafe conditions in the roadways leading to the site. The latter was equipped with remote monitoring system, but most of the instruments could not tolerate rapid closures in the carnallitic ore and failed. Consequently, the sites could not be monitored to the point where the overburden reloading would be experienced and the long-term steady state conditions would occur.

As a consequence of the above, the long-term effects, i.e. magnitude of roof extension, the extension of floor intrusion into the room, the steady state displacements and strains and the steady state stresses under full load equilibrium could not be determined. However, the initial response of mining rooms was well established and a valuable experience was gained for the future research programs.

SECTION 9.0

9.0 RECOMMENDATIONS

1. In the area of laboratory testing, the future creep tests should be conducted at low range of devatoric stresses. This testing will require greater number of tests and much longer time periods than was allowed under the present program, but it is mandatory in order to gain further insight into the material behaviour under the long-term conditions in the mine.

2. In situ testing must utilize instrumentation which is capable of withstanding rapid closure rates in carnallitic ore without failure. Such instrumentation is now available. The remote data acquisition system was successfully recovered and is available for future work. The monitoring period should include at least two years after the panel mining has been completed and should be combined with surface subsidence measurements in the same area.

3. Recent developments in microseismic monitoring systems allow a close correlation of mining induced seismic events with underground monitoring and surface subsidence monitoring. The microseismic monitoring of the mining area under research should be included in future programs.

APPENDIX A

APPENDIX A

Daily Log of Installation Activities - Panel 13H

The log of activities associated with coring of laboratory samples, drilling and installation of instrumentation at the Rock Mechanics Station Room 13H040 follows:

K-2 MINE, PANEL 13H, ROOM 13H040
LOW CARNALLITE ROCK MECHANICS STATION
DAILY LOG OF ACTIVITIES

DATE	FOOTAGE DRILLED	SHIFT	DESCRIPTION
Nov.25/86	-	-	Prepared pressure cells
Dec.15/86	-	-	Mobilize for core drilling
Dec.16/86	-	-	Mobilize for core drilling
Jan.19/86	-	-	Drill core
Jan.20/87	-	-	Drill core
Jan.21/87	-	-	Drill core
Jan.22/87	-	-	Drill core
Jan.23/87	-	-	Demobilize for core drilling Mobilize for instrumentation drilling
Jan.26/87	-	-	Compressor problems-no drilling
Jan.27/87	10'	D/S	String ventilation tubing, set up diesel compressor
Jan.28/87	20'	D/S	Drilling ok
	30'	A/S	Drilling ok
Jan.29/87	30'	D/S	Drilling ok
	32'	A/S	Drilling ok
Jan.30/87	5'	D/S	Compressor overheating
	23'	A/S	Compressor overheating/finished south wall drilling
Feb.2/87	15'	D/S	Finished north wall drilling, mine to "cut-out"
	27'	A/S	Drilling ok, in "cut-out" area
Feb.3/87	25'	D/S	Compressor relief valve problems
	15'	A/S	Compressor relief valve problems Finished second 40' hole
Feb.4/87	0	D/S	Drill chuck slipping, tried rock bolt compressor/Grouted plugs for south wall pressure cells
	0	A/S	Rock bolter compressor too small to use for drilling

K-2 MINE, PANEL 13H, ROOM 13H040
LOW CARNALLITE ROCK MECHANICS STATION
DAILY LOG OF ACTIVITIES
(Continued)

DATE	FOOTAGE DRILLED	SHIFT	DESCRIPTION
Feb.5/87	(30)	D/S	Drilled 5', 10' and 15' ext holes in north wall/Installed closure pins. Grouted in 5', 10', 15', 20', and 25' pressure cells on south wall.
		A/S	No shift
Feb.6/87	0	D/S	Check grouting, redid 15' press. cell Compressor still down, no drilling
	13'	A/S	SRC bit stuck in hole
Feb.9/87	25'	D/S	Broken head bolt on drill
	15'	A/S	Drilled at set up for 4th 40' hole in "cut-out"
Feb.10/87	0	D/S	IMC bit broke off 10' in hole/Tried to recover SRC bit, broke off in hole Prepared for extensometer hole drilling
Feb.11/87	(50)	D/S	Drilled 50' extensometer hole in south wall
Feb.12/87	0	D/S	No drilling, no bits Surveyors picked up holes in "cut-out"
Feb.13/87	(20)	D/S	Drilled 20' of 30' extensometer hole in roof/No 2 1/8" drilling, no bits
Feb.17/87	(10)	D/S	Drilled 10' remaining for extenso-meter hole in roof/No 2 1/8" drilling, no bits
Feb.18/87	0	D/S	Installed grout plugs in 3 of 40' holes in "cut-out"/No 2 1/8" drilling, no bits
Feb.19/87	0	D/S	No 2 1/8" drilling, no bits/Checked pressurization on cell in south wall Connected up extensometer in south wall New 2 1/8" bit arrived
Feb.20/87	29'	D/S	Drilling ok
	22'	A/S	Drilled and set up for last 40' hole in "cut-out"
Feb.23/87	0	D/S	Broken coupler, prepared rest of pressure cells
	0	A/S	Compressor down, overheating

K-2 MINE, PANEL 13H, ROOM 13H040
LOW CARNALLITE ROCK MECHANICS STATION
DAILY LOG OF ACTIVITIES
(Continued)

DATE	FOOTAGE DRILLED	SHIFT	DESCRIPTION
Feb.24/87	7'	D/S	Installed roof extensometer Compressor down, taken to shop
Feb.25/87	13'	D/S	Compressor picked up from shop/Repaired broken channel in roof extensometer/Began pressurizing south wall cells to 5,000 psi
Feb.26/87	20'	D/S	Repressurizing cells and securing joints Cell preparation for up holes
	20'	A/S	Drilling ok
Feb.27/87	-	D/S	Cleaned up drill and parts, ready to move
Mar.2/87	4	D/S	Attempted to drill downholes with Unibolt II-not successful/Installed pressure cells in up holes and grouted in plugs
Mar.3/87	60'	D/S	Began grouting up holes at 10:00 am/Pump stopped working after 2 holes grouted
Mar.4/87	25	D/S	Drilled new 25' hole for cell on south wall/Made up new 25' cell/Got grout pump working/Took north wall extensometer readings/Repressurized cells
Mar.5/87	-	D/S	Installed 25' cell in south wall/Grouted 15' cell in north wall and remaining up holes/Ran out of grout
Mar.6/87	-	D/S	Repressurized cells/Installed closure meter in center of room/Flagged area and installed pressure gauges on cells in the roof
Mar.9/87	-	D/S	Cut and welded rods for floor extensometers/Repressurized cells
Mar.11/87	-	D/S	Redid 15' hole as pressure line was plugged/Hooked everything up, but compressor would not start/Towed compressor to shop
Mar.12/87	-	D/S	Borrowed compressor from T.M.C.C./Grouted 25' cell in south wall and radial cells in south wall "cut-out"/Recorded extensometers and south wall gauges
Mar.20/87	-	D/S	Pressurized cells that were grouted on March 12/87 and took another set of readings

Total 2 1/8" diameter drilling to March 4 = 485' (100% complete).

Total 1 3/8" diameter drilling to end of February = 110' (100% complete).

Daily Log of Activities - Panel 12E

The log of activities associated with coring of laboratory samples, drilling and installation of instrumentation at the Rock Mechanics station in Room 12E024 follows:

K-1 MINE, PANEL 12E, ROOM 12E024
HIGH CARNALLITE ROCK MECHANICS STATION
DAILY LOG OF ACTIVITIES

DATE	FOOTAGE DRILLED	SHIFT	DESCRIPTION
May 12/87	-	D/S	Mobilize for instrumentation drilling
May 13/87	5	D/S	Set up drill-east wall
May 14/87	5	D/S	Move drill, bit modifications
May 15/87	24.5	D/S	Drilling ok-east wall Made bracket for forklift to move drill
May 19/87	45.5	D/S	Drilling ok-east wall Preparing pressure cells
May 20/87	0	D/S	Moved drill
May 21/87	40	D/S	Drilling ok-east wall Brattice erected for ventilation
May 22/87	30	D/S	Drilling ok-east wall
May 25/87	13	D/S	Drilling ok-east wall
May 26/87	6	D/S	Extensometer hole completed Preparing pressure cells
May 27/87	32	D/S	Drilling ok-east wall Preparing pressure cells
May 28/87	20	D/S	Drilling ok-west wall Moved drill four times
May 29/87	32	D/S	Drilling ok-west wall Put plugs in east wall pressure cells
June 1/87	30	D/S	Finished west wall drilling Moved to first 40' radial stress hole
June 2/87	21	D/S	Finished first 40' hole. Moved drill
June 3/87	37	D/S	Finished second 40' hole Moved drill to third 40' hole
June 4/87	30	D/S	Drilling ok until swivel broke Repaired swivel

K-1 MINE, PANEL 12E, ROOM 12E024
HIGH CARNALLITE ROCK MECHANICS STATION
DAILY LOG OF ACTIVITIES
(Continued)

DATE	FOOTAGE DRILLED	SHIFT	DESCRIPTION
June 5/87	27	D/S	Finished third 40' hole Moved drill to fourth 40' hole
June 8/87	25	D/S	Finished fourth 40' hole Moved to ream extensometer hole Cleaned air filters and blew out compressor
June 9/87	35	D/S	Drilling ok Reamed out 35' of 50' extensometer hole
June 10/87	15	D/S	Drill steel broke apart in hole Extracted steel/Drilling completed for instrumentation/Started installing extensometer anchors
June 11/87	-	D/S	Finished installation of extensometer anchors/Making up pressure cells
June 12/87	-	D/S	Completed making up pressure cells Installed cells and grout plugs
June 15/87	-	D/S	Rounded up fittings for grouting Setting up roof extensometer
June 16/87	-	D/S	Finished extensometer installation Setting up to drill core/Obtained grout pump, mixer and core bit
June 17/87	-	D/S	Grouted pressure cells
June 19/87	-	D/S	Coring until noon/Made up last 2 pressure cells and installed with plugs/Finished grouting last 3 cells/Cleaned hoses, mixer and grout pump

Total 2 1/8" diameter drilling to June 10 = 473' (100% complete).

APPENDIX B

APPENDIX B

Drilling Requirements for Installations In Panel 13H

The drilling requirements associated with the installation of instrumentation at the Rock Mechanics Station in Room 13H040 follows:

K-2 MINE, PANEL 13H, ROOM 13H040
LOW CARNALLITE ROCK MECHANICS STATION
DRILLING REQUIREMENTS - 2 1/8" DIAMETER

HOLE LOCATION	HOLE DEPTH (Feet)	PURPOSE OF DRILL HOLE
South wall	5	Install 5' depth vertical stress SRC cell
	5	Install 5' depth lateral stress SRC cell
	10	Install 10' depth vertical stress SRC cell
	10	Install 10' depth lateral stress SRC cell
	15	Install 15' depth vertical stress SRC cell
	15	Install 15' depth lateral stress SRC cell
	20	Install 20' depth vertical stress SRC cell
	20	Install 20' depth lateral stress SRC cell
	25	Install 25' depth vertical stress SRC cell
	25	Install 25' depth lateral stress SRC cell
Subtotal	150	
North wall	15	Install 15' depth vertical stress SRC cell
Subtotal	15	
South wall	40	Install 5' depth radial stress SRC cell
	40	Install 10' depth radial stress SRC cell
	40	Install 15' depth radial stress SRC cell
	40	Install 20' depth radial stress SRC cell
	40	Install 25' depth radial stress SRC cell
Subtotal	200	
Roof	10	Install 10' depth horiz. stress SRC cell
	10	Install 10' depth lateral stress SRC cell
	20	Install 20' depth horiz. stress SRC cell
	20	Install 20' depth lateral stress SRC cell
Subtotal	60	

K-2 MINE, PANEL 13H, ROOM 13H040
LOW CARNALLITE ROCK MECHANICS STATION
DRILLING REQUIREMENTS - 1 3/8" DIAMETER

HOLE LOCATION	HOLE DEPTH (Feet)	PURPOSE OF DRILL HOLE
Floor	10	Install 10' depth extensometer
	20	Install 20' depth extensometer
	30	Install 30' depth extensometer
Subtotal	60	
GRAND TOTAL	485	
South wall	48	Install 6-point extensometer
Subtotal	48	
North wall	5	Install 5' depth rod and plate ext.
	10	Install 10' depth rod and plate ext.
	15	Install 15' depth rod and plate ext.
Subtotal	30	
Roof	30	Install 6-point extensometer
Subtotal	30	
GRAND TOTAL	108	

Drilling Requirements for Installations in Panel 12E

The drilling requirements associated with the installation of instrumentation at the Rock Mechanics Station in Room 12E024 follows:

K-1 MINE, PANEL 12E, ROOM 12E024
HIGH CARNALLITE ROCK MECHANICS STATION
DRILLING REQUIREMENTS - 2 1/8" DIAMETER

HOLE LOCATION	HOLE DEPTH (Feet)	PURPOSE OF DRILL HOLE
East wall	5	Install 5' depth vertical stress SRC cell
	5	Install 5' depth lateral stress SRC cell
	10	Install 10' depth vertical stress SRC cell
	10	Install 10' depth lateral stress SRC cell
	15	Install 15' depth vertical stress SRC cell
	15	Install 15' depth lateral stress SRC cell
	20	Install 20' depth vertical stress SRC cell
	20	Install 20' depth lateral stress SRC cell
	50	Install 50' depth vertical stress SRC cell
	50	Install 50' depth lateral stress SRC cell
	50	Install 50' 6-point extensometer
Subtotal	250	
West wall	5	Install 5' depth vertical stress SRC cell
	5	Install 5' depth lateral stress SRC cell
	10	Install 10' depth vertical stress SRC cell
	10	Install 10' depth lateral stress SRC cell
	15	Install 15' depth vertical stress SRC cell
	15	Install 15' depth lateral stress SRC cell
Subtotal	60	
East wall "cut-out"	40	Install 5' depth radial stress SRC cell
	40	Install 10' depth radial stress SRC cell
	40	Install 15' depth radial stress SRC cell
	40	Install 20' depth radial stress SRC cell
Subtotal	160	
GRAND TOTAL	470	